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ABSTRACT

This learning module, one of a series of 127 performance-based teacher education learning packages focusing on specific professional competencies of vocational teachers, deals with the task of assisting students in developing technical reading skills. Addressed in the individual learning experiences included in the module are the following topics: the importance of technical reading in vocational programs (fusing the teaching of reading and content, assessing student needs and abilities, using additional resources, and understanding the reading process); development of vocabulary exercises (context clues, structural analysis, oral vocabulary instruction, and word puzzles and games); development of comprehension skills (levels of comprehension, strategies in reading for main ideas and details, and techniques for questioning and for helping students recognize patterns); development of graphics reading exercises; and formulation of a plan to teach technical reading skills (reading and analyzing materials, using a text analysis chart, introducing reading materials, and developing a study guide and enrichment activities). Each learning experience contains an objective, one or more learning activities, and a feedback activity. The module provides student teachers with the opportunity to examine case studies; develop instructional materials, exercises, and a teaching plan; and assist students in developing technical reading skills in an actual teaching situation. (MN)

ED252702

Assist Students in Developing Technical Reading Skills

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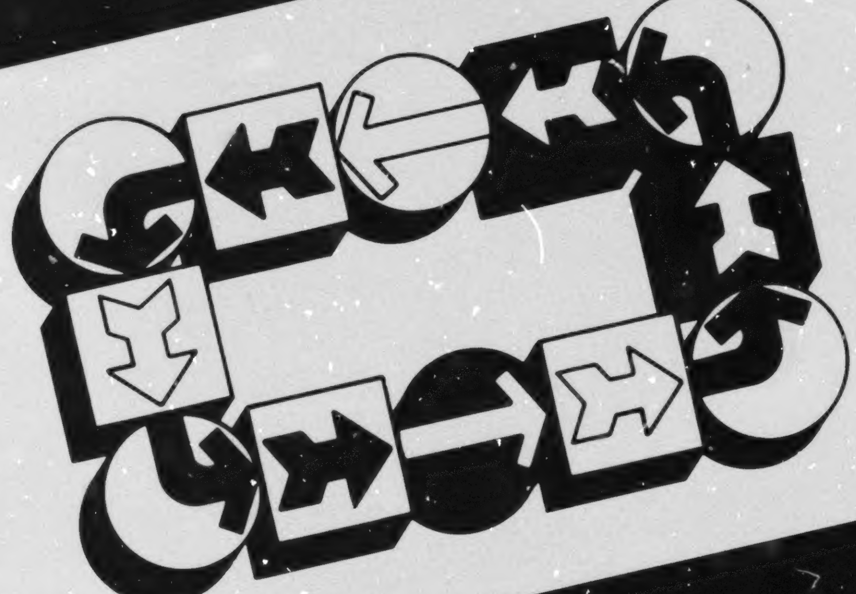

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FOREWORD

This module is one of a series of 127 performance-based teacher education (PBTE) learning packages focusing upon specific professional competencies of vocational teachers. The competencies upon which these modules are based were identified and verified through research as being important to successful vocational teaching at both the secondary and postsecondary levels of instruction. The modules are suitable for the preparation of teachers and other occupational trainers in all occupational areas.

Each module provides learning experiences that integrate theory and application; each culminates with criterion-referenced assessment of the teacher's (instructor's, trainer's) performance of the specified competency. The materials are designed for use by teachers-in-training working individually or in groups under the direction and with the assistance of teacher educators or others acting as resource persons. Resource persons should be skilled in the teacher competencies being developed and should be thoroughly oriented to PBTE concepts and procedures before using these materials.

The design of the materials provides considerable flexibility for planning and conducting performance-based training programs for preservice and inservice teachers, as well as business-industry-labor trainers, to meet a wide variety of individual needs and interests. The materials are intended for use by universities and colleges, state departments of education, postsecondary institutions, local education agencies, and others responsible for the professional development of vocational teachers and other occupational trainers.

The PBTE curriculum packages in Category M—Assisting Students in Improving Their Basic Skills—are designed to enable vocational teachers and other occupational trainers to integrate the teaching and reinforcement of basic skills into their regular vocational instruction. The modules are based upon 85 teacher competencies identified as essential for vocational teachers to teach and to reinforce basic communication, computation, and employment skills as part of the ongoing occupational education program.

Many individuals and institutions have contributed to the research, development, testing, and revision of these significant training materials. Appreciation is extended to the following individuals who, as members of the DACUM analysis panel, assisted National Center staff in the identification of the teacher competency statements upon which this category of modules is based: Milton Arnold, Lewis Cain, William Chandler, Jim Frazier, Jackie Marshall, Teresa Paige, Thomas Peterson, Marie Schernitz, and Nancy Underwood.

Field testing of the materials was carried out with the assistance of field-site coordinators, teacher educators, students, directors of staff development, and others at the following institutions: University of Alabama-Birmingham; Albuquerque Technical-Vocational Institute, New Mexico; University of Central Florida; Dupage Area Vocational Education Authority, Wisconsin; Holland College, P.E.I., Canada; Seminole Community College, Florida; University of Southern Maine; and Temple University, Pennsylvania.

Special recognition is extended to Glen E. Fardig, Gail West, and to the University of Central Florida for the initial development of this module and for their permission to adapt and integrate their work into this category of basic skills modules.

Recognition for major individual roles in the further development of these materials is extended to the following National Center Staff: Lucille Campbell-Thrane, Associate Director, Development Division, and James B. Hamilton, Program Director, for leadership and direction of the project; Lois G. Harrington and Michael E. Wonacott, Program Associates, for module quality control; Cheryl M. Lowry, Research Specialist, for developing illustration specifications; Barbara Shea for art work; Adonia Simandjuntak, Graduate Research Associate, for assistance in field-test data summarization; and Catherine C. King-Fitch and Michael E. Wonacott, Program Associates, for revision of the materials following field testing.

Special recognition is also extended to the staff at AAVIM for their invaluable contributions to the quality of the final printed products, particularly to Donna Pritchett for module layout, design, and final art work, and to George W. Smith, Jr. for supervision of the module production process.

Robert E. Taylor
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MODULE
M-2

Assist Students in Developing Technical Reading Skills

Module M-2 of Category M—Assisting Students in Improving Their Basic Skills
PROFESSIONAL TEACHER EDUCATION MODULE SERIES

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INTRODUCTION

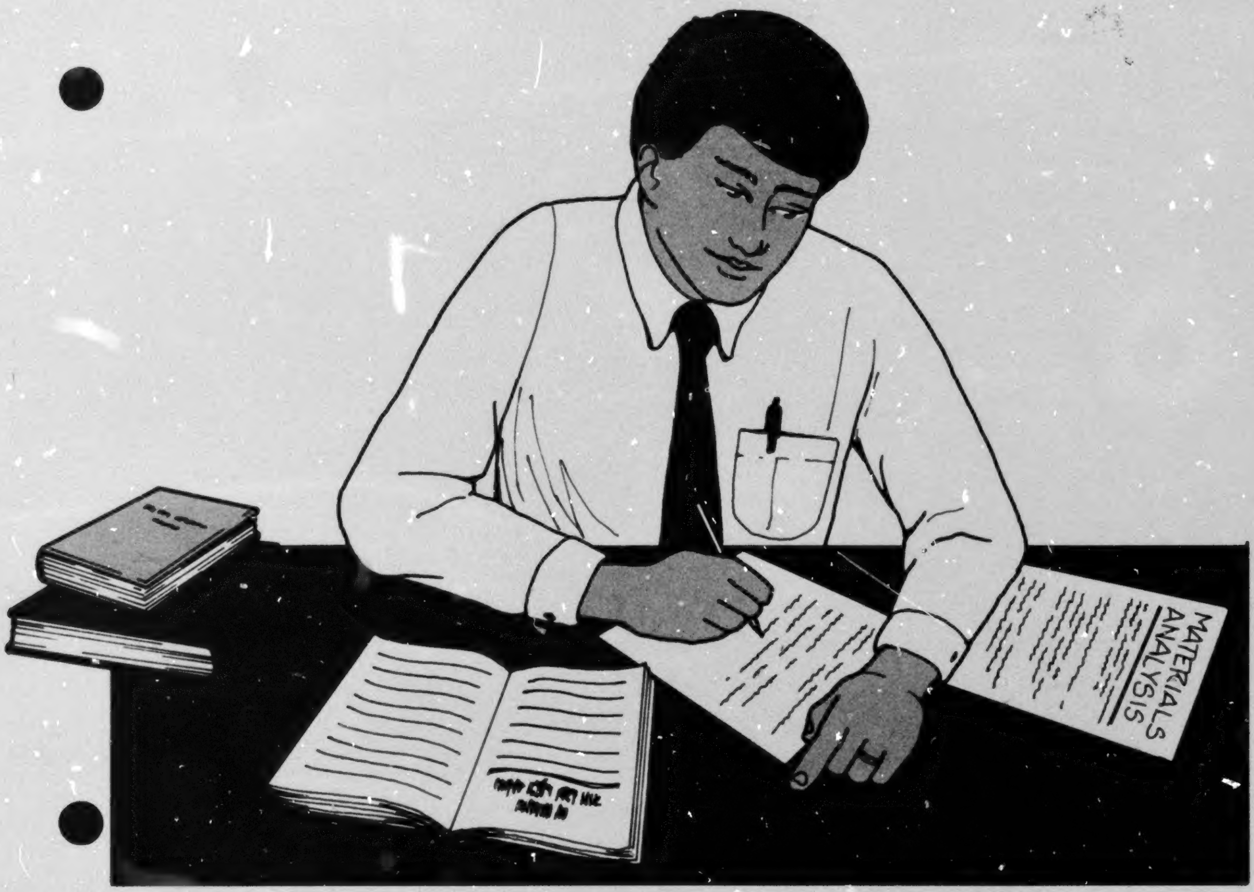
Vocational-technical teachers may be confronted with students who lack the skills needed to meet the reading demands of their programs. Despite the abundance of audiovisual materials and frequent use of teacher demonstrations in occupational programs, students still must use printed materials.

Each vocational-technical area uses special materials that are likely to involve unusual formats and a great deal of factual information. Some printed materials may have a great deal of technical vocabulary and a number of complex concepts and processes. As a vocational-technical teacher, you must take action to narrow the gap between students' technical reading skills and the reading demands of the program materials.

If you are untrained in the teaching of reading, you may have the notion that reading instruction is a mysterious activity conducted in a reading laboratory by a reading specialist. It is true that **remedial reading** instruction is often the job of the trained reading specialist. However, learning to read and learning to read technical materials are not synonymous.

The remedial reading specialist's job is (1) to **analyze students' reading abilities** to determine what general reading skills they lack and then (2) to find specific materials that will aid in acquiring or improving those skills. Your job as a vocational teacher is (1) to **analyze program materials** to determine what reading skills students need in order to understand and apply the information and then (2) to help students develop the skills they lack.

You do not need to be a reading specialist, but you must know how to apply the reading skills and thinking processes needed to "make sense" out of instructional materials. This module is designed to give you skill in helping students develop their technical reading skills so that they can handle the materials in your program and, ultimately, in the occupation.



ABOUT THIS MODULE

Objectives

Terminal Objective: In an actual teaching situation, assist students in developing technical reading skills. Your performance will be assessed by your resource person, using the Teacher Performance Assessment Form, pp. 87–88 (*Learning Experience VI*).

Enabling Objectives:

1. After completing the required reading, demonstrate knowledge of the rationale and procedures for teaching technical reading skills in vocational programs (*Learning Experience I*).
2. After completing the required reading, develop vocabulary exercises based on vocational instructional materials (*Learning Experience II*).
3. After completing the required reading, develop comprehension exercises based on vocational instructional materials (*Learning Experience III*).
4. After completing the required reading, develop graphics reading exercises based on vocational instructional materials (*Learning Experience IV*).
5. After completing the required reading, analyze vocational instructional materials (*Learning Experience V*).

Prerequisites

The modules in Category M are **not** designed for the prospective teacher with no prior training and/or experience. They assume that you have achieved a minimal level of **content knowledge** in your occupational specialty and **skill** in the core teacher competencies of instructional planning, execution, and evaluation. They then build on or expand that knowledge and skill level, specifically in terms of assisting students in improving their basic skills.

Resources

A list of the outside resources that supplement those contained within the module follows. Check with your resource person (1) to determine the availability and the location of these resources, (2) to locate additional references in your occupational specialty, and (3) to get assistance in setting up activities with peers or observations of skilled teachers, if necessary. Your resource person may also be contacted if you have any difficulty with directions or in assessing your progress at any time.

Learning Experience I

Optional

Reference: Herber, Harold L. *Teaching Reading in Content Areas.* Second Edition. Englewood Cliffs, NJ: Prentice-Hall, 1978.

A reading specialist to assess your reading competency and to provide instruction or instructional materials for your own reading skill development.

Reference: Schwartz, Beth. "Can Your Students Read [illegible] Textbooks?" *Florida Vocational Journal.* V (December 1979/January 1980): 25–27.

Learning Experience II

Required

Instructional materials for your own occupational specialty (e.g., textbooks, manuals, workbooks) for which you can develop vocabulary exercises.

A resource person to evaluate your competency in developing vocabulary exercises.

Learning Experience III

Required

Instructional materials for your own occupational specialty (e.g., textbooks, manuals, workbooks) for which you can develop comprehension exercises.

A resource person to evaluate your competency in developing comprehension exercises.

Learning Experience IV

Required

Instructional materials for your own occupational specialty (e.g., textbooks, manuals, workbooks) for which you can develop graphics reading exercises.

A resource person to evaluate your competency in developing graphics reading exercises.

Learning Experience V

Required

Instructional materials for your own occupational specialty (e.g., textbooks, manuals, workbooks) that you can analyze to determine the reading skills needed.

A resource person to evaluate your competency in analyzing instructional materials.

Optional

Reference: Shepherd, David L. *Comprehensive High School Reading Methods.* Second Edition. Columbus, OH: Charles E. Merrill Publishing Company, 1978.

Reference: Thomas, Ellen L., and Robinson, H. Alan. *Improving Reading in Every Class: A Sourcebook for Teachers.* Second Edition. Boston: Allyn and Bacon, 1977.

Learning Experience VI

Required

An actual teaching situation in which you can assist students in developing technical reading skills.

A resource person to assess your competency in assisting students in developing technical reading skills.

General Information

For information about the general organization of each performance-based teacher education (PBTE) module, general procedures for its use, and terminology that is common to all the modules, see About Using the National Center's PBTE Modules on the inside back cover. For more in-depth information on how to use the modules in teacher/trainer education programs, you may wish to refer to three related documents:

> The *Student Guide to Using Performance-Based Teacher Education Materials* is designed to help orient preservice and inservice teachers and occupational trainers to PBTE in general and to the PBTE materials.
>
> The *Resource Person Guide to Using Performance-Based Teacher Education Materials* can help prospective resource persons to guide and assist preservice and inservice teachers and occupational trainers in the development of professional teaching competencies through use of the PBTE modules. It also includes lists of all the module competencies, as well as a listing of the supplementary resources and the addresses where they can be obtained.
>
> The *Guide to the Implementation of Performance-Based Teacher Education* is designed to help those who will administer the PBTE program. It contains answers to implementation questions, possible solutions to problems, and alternative courses of action.

NOTES

Learning Experience I

OVERVIEW

Enabling Objective

After completing the required reading, demonstrate knowledge of the rationale and procedures for teaching technical reading skills in vocational programs.

Activity 1

You will be reading the information sheet, Technical Reading in Vocational Programs, pp. 9–14.

Optional Activity 2

You may wish to read the following supplementary reference: Herber, *Teaching Reading in Content Areas*, pp. 1–36.

Optional Activity 3

You may wish to meet with a reading specialist who can assess your reading skills and suggest materials or provide instruction that will help you improve your reading skills.

Optional Activity 4

You may wish to read the following supplementary reference: Schwartz, "Can Your Students Read Their Textbooks?" *Florida Vocational Journal*.

Activity 5

You will be demonstrating knowledge of the rationale and procedures for teaching technical reading skills in vocational programs by completing the Self-Check, pp. 15–16.

Feedback
[illegible]

You will be evaluating your competency by comparing your completed Self-Check with the Model Answers, pp. 17–18.

Activity 1

For students to be successful in your vocational-technical program, they must be able to do certain kinds of technical reading. If any of your students have difficulty with the technical reading requirements, you must be prepared to help them. For information concerning the reading process and the rationale and procedures for teaching technical reading skills in occupational programs, read the following information sheet.

TECHNICAL READING IN VOCATIONAL PROGRAMS

Vocational teachers often ask why students haven't been taught to read in the elementary schools. They have—but reading in the primary grades is an **end** unto itself. That is, the purpose is to teach children how to read. Although some children may not have learned how to read well in the primary grades (for any number of reasons), their elementary teachers did attempt to teach them.[1]

In vocational-technical areas, reading instruction becomes a **means** to an end. That is, the purpose is to teach students how to read the specific technical materials they need to use in class and on the job. Elementary teachers are not trained to do this, nor are secondary reading specialists.

Learning to read is a continual process. As students progress through school, each subject has its own vocabulary, its distinctive requirements for comprehension, its unique materials.

Beginning-level reading instruction, as provided by the elementary teacher, may not be enough to enable some students to cope with specialized materials. Remedial reading instruction, as provided by high school reading specialists, is generally designed to serve those students who have severe problems—who need special help just coping with basic reading skills.

Therefore, regular classroom teachers must assume the responsibility for teaching the students in their classes to read the materials specific to each of their programs. As a result, many states and local school districts are now requiring all teachers in all content areas to receive some training in the teaching of reading.

The problem of reading technical materials is not confined to secondary-level students, of course. Adult students may also need assistance in learning how to read these materials. Some students may have weak educational backgrounds, and others may have learned English as a second language. All students, including very capable readers, may need instruction in dealing with the specialized materials of the occupation.

Just about every occupational area includes technical materials that require special reading skills—skills that you cannot expect students to pick up on their own. In electronics there are schematic drawings to be read. In auto mechanics there are manufacturers' specification sheets that students must follow. In computer programming there is a whole new language to be learned.

In almost all occupational programs, students must understand and remember complex technical terms. They must be able to locate information in reference manuals. And they must be able to follow step-by-step procedural directions.

Usually, being able to read and comprehend is critical to doing a good job—or even advancing in an occupation. In some situations, it might be a matter of life and death. Consider the pilot of a small plane, preparing to land at a strange airport as darkness descends. When that pilot gets out the approach-and-landing manual, it is vital that he or she be able to locate and read the proper approach chart.

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[1] Some of the material for this and subsequent information sheets has been adapted from Gail B. West, *Teaching Reading Skills in Content Areas: A Practical Guide to the Construction of Student Exercises* (Oviedo, FL: Sandpiper Press, 1978).

Your Role

You, as a vocational-technical instructor, need to work both to **extend** and to **develop** your students' reading skills. Extension means the adaptation of reading skills introduced in the primary grades to the more difficult, technical materials encountered in your program. Development means the teaching of new, unique skills required in your occupational area. This is developmental reading, not remedial reading.

Developmental reading is not designed only for those students who are having difficulties in reading, but for **all** students—even superior ones. You cannot assume that students who can read well know how to read the schematics or complicated diagrams that appear in your instructional materials. As an occupational specialist, you can teach them how to do this. It is unlikely that anyone else will, so the responsibility is yours.

You may feel very uneasy about the prospect of teaching technical reading skills if your own reading skills are weak. It may have been some time since you were a student yourself, and you may not have had much time for reading recently. Over the years, you may have picked up some poor reading habits that slow you down or interfere with comprehension.

Whatever the reason, if you need first to sharpen your own reading skills (and everyone can improve), reading help is available. Reading centers, for example, are available in many educational institutions, whether at the secondary, two-year postsecondary, or college/university level.

Many services are provided at those centers for adults with various needs—from those who are functionally illiterate to graduate students who want to refine their reading skills and improve their reading speed. The most difficult part may be to admit that you need help and then to seek it.

As your own reading skills improve, you will be in a much better position to help students. You are, after all, the most logical one to help students with the technical reading skills required in your program. You know your students. You are available to them. And you are an expert in your occupational area and know best the essential skills students need in order to perform well.

Fusing the Teaching of Reading with Content

Occupational teachers are sometimes confused about how reading should be taught in their classes. Some have thought that they would have only four days a week to teach auto mechanics, for example, if one day had to be spent on reading. They have said that they don't have time enough as it is to do all that is needed to teach auto mechanics, much less reading and study skills.

Step 1
Step 2
Step 3

This is a misconception of how reading should be taught in vocational-technical programs. What is intended is that **while** students are learning auto mechanics, they should also be learning the skills necessary to understand, study, remember, and apply the program content.

You can incorporate technical reading instruction into your program through a variety of means. Some of these might be quite unobtrusive—you can smuggle in the teaching of reading when the students' backs are turned, so to speak. At other times, you will want to tackle the problem directly with reading activities and exercises.

In the course of a lesson, for example, you can present new technical terms, analyze what their roots mean, give the definitions, and help students remember the words. You can devote a class discussion to the process of locating information in reference manuals. You can build a laboratory demonstration around the task of following a set of written instructions. As students work on lab projects or activities, they can develop skills in reading job sheets.

You can correlate reading the textbook or reading the information sheets in learning guides with special teacher-made reading exercises. You can use well-made training films not only to teach subject matter, but to extend students' vocabulary. It should be apparent that teaching reading in these ways does not occur by accident; it is thoroughly planned, organized, and executed.

Information and skills are more effectively taught within a context in which they may be directly **applied.** In other words, reading competence improves when students focus on content and not merely on "reading." As students engage in the development of technical reading skills, they will be learning not only the content, but also **how to learn** auto mechanics, welding, nursing, cosmetology, or whatever.

Students will have to continue to update their occupational knowledge and skills once they are on the job. Thus, it is important that they acquire learning/reading/study skills while still in school. These skills will enable them to keep current and improve their skills long after they have left your program.

Developing students' technical reading skills can be done equally well whatever the instructional approach of the program. Instructors in individualized, competency-based training programs have the same responsibilities in this matter as teachers working in more conventional programs. Only the vehicle of instruction and the approach will differ.

In a competency-based education (CBE) program, the communications skills (competencies) required on the job should be identified at the same time, and by the same research method, as other occupational competencies. Thus, whether the competencies in your program are derived from a V-TECS catalog, a DACUM analysis, or some other type of occupational analysis, the reading skills among them will form the basis for your developmental reading activities. Students must achieve these skills just as they must achieve the more obvious technical skills.

To provide reading instruction, CBE programs generally employ strategies and materials similar to those used to teach other occupational skills. Learning guides, for instance, may include one or two learning activities specifically designed to strengthen students' reading ability. In other instances, an entire learning guide may be devoted to helping students master a reading-intensive competency, such as reading flow charts or manufacturers' specification sheets. Of course, one-to-one or small-group instruction can also be used for this purpose.

Student Needs and Abilities

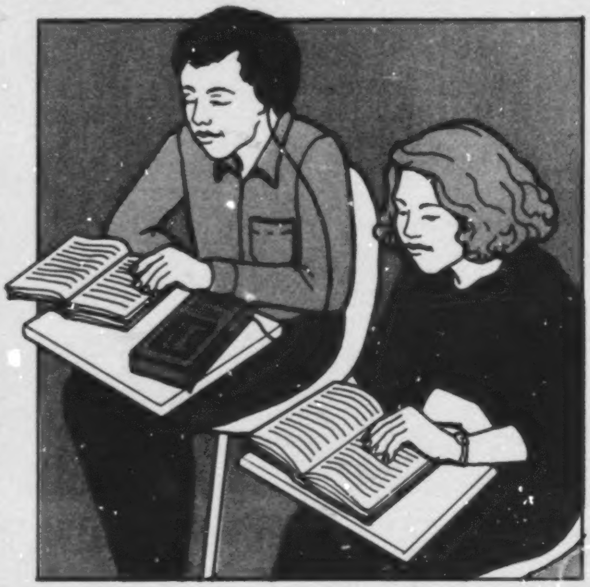
You will not be teaching reading in a vacuum. You will be teaching your own students, with their own particular set of needs and abilities. In order to meet those needs, take advantage of those abilities, and expend your own time and effort most efficiently, you must **know your students.**

Vocational-technical students, like students in any program, arrive with a great range of educational backgrounds and personal skills. You cannot assume that a student's reading level is the same as his/her grade level in school. It does little good to complain that students in your program are reading on every level from third grade through twelfth grade. It does a great deal of good, however, to know each individual's approximate reading level and to determine whether he or she has any specific reading problems.

Information about your students can be very valuable to you as you plan your program. You need to be sure that the reading activities you assign are not at a level of difficulty that will create student frustration. At the same time, they should not be at so low a level that more capable readers become bored and resentful.

If you are not obligated to use state-adopted texts, you could select textbooks or learning guides to match the reading abilities of your students. If you develop learning guides or information sheets, you can learn to pitch them at the appropriate reading level for students in your program. As you prepare project sheets, reading assignments, and reading exercises, knowledge of your students' abilities and needs will be invaluable.

In some cases, you may be able to develop learning activities at two or more levels of reading skill. Making cassette tape recordings of regular reading assignments is an example of this approach. At the program resource center (or simply at their desks), students whom you know to have poor reading skills can listen to a tape recording of the assignment, while following along in the printed text.



By both reading and listening, students will have a chance to learn the material and, at the same time, to learn to associate the written word with the spoken word. Don't worry if you don't have the voice and delivery of a professional radio announcer. Students will recognize your voice on the recording and accept it.

In order to make these kinds of plans for your students, you will need to seek out information about their reading abilities. There are several ways you can do this. You can derive information from schoolwide standardized reading tests. You can administer commercially produced survey tests. Or you can devise an informal reading inventory for your own classes. Each approach has its benefits and difficulties.

Many schools, particularly at the secondary level, give **schoolwide reading tests** to provide information to teachers and others concerned with the education of students. A counselor or other testing specialist can provide you with information about each test and how to interpret test scores.

If available, reading scores for individual students can usually be found in the cumulative records filed in the school office. An examination of the overall and subtest scores will tell you, for example, that a particular student reads at the ninth-grade level. It may, in addition, pinpoint the student's specific reading strengths and weaknesses.

You can also obtain **standardized survey tests** that can be administered to a group of students, usually within a single class period. Most survey tests have at least two parts—vocabulary and paragraph comprehension. The scores on such tests simply provide a rough estimate of students' abilities and do not measure their ability to read or perform within the occupational content area.

Finally, you can construct **informal reading inventories** based on the textbook and other reading materials used in your program. Such inventories help to determine students' ability to read in your specific occupational area. Having determined the reading skills especially important in your area (e.g., reading graphics, procedure manuals, and diagrams), you can devise a class-period inventory using the materials from your own program.

Such inventories take some time to construct initially, but they can be reused many times. A good reference book on reading methods will provide information on how to construct a simple reading inventory.

Additional Resources

It has been said earlier that vocational-technical instructors are expected to be developmental reading teachers, not remedial reading teachers. Still, you will not necessarily be working alone to improve students' technical reading skills. You may often be able to cooperate with other school or college personnel who have similar responsibilities.

When you discover a student who has a significant reading problem, you need to enlist special help. For example, your school or college may have a **remedial reading program** designed to improve students' basic reading skills. Such programs are staffed by **reading specialists** who are trained to use the best contemporary techniques and materials. As part of the program, there may be a **reading lab,** elaborately equipped, supplied with a wide variety of program materials, and open for student use any time of the school day.

Even though reading specialists may make every effort to identify students with special needs, they depend upon teachers to refer to them any cases they may have missed. If you suspect that a particular student has difficulties, it is probably best to have an informal conversation with a reading specialist or counselor, outlining the student's performance as you have observed it. There is no need for you to make a diagnosis or suggest a course of action; that is the responsibility of the reading program staff.

In some institutions, especially at the postsecondary level, the student must be the one to initiate a request for help. In that case, you could have an informal conference with the student, noting what you have observed about his/her reading abilities and recommending that the student seek help through the reading program.

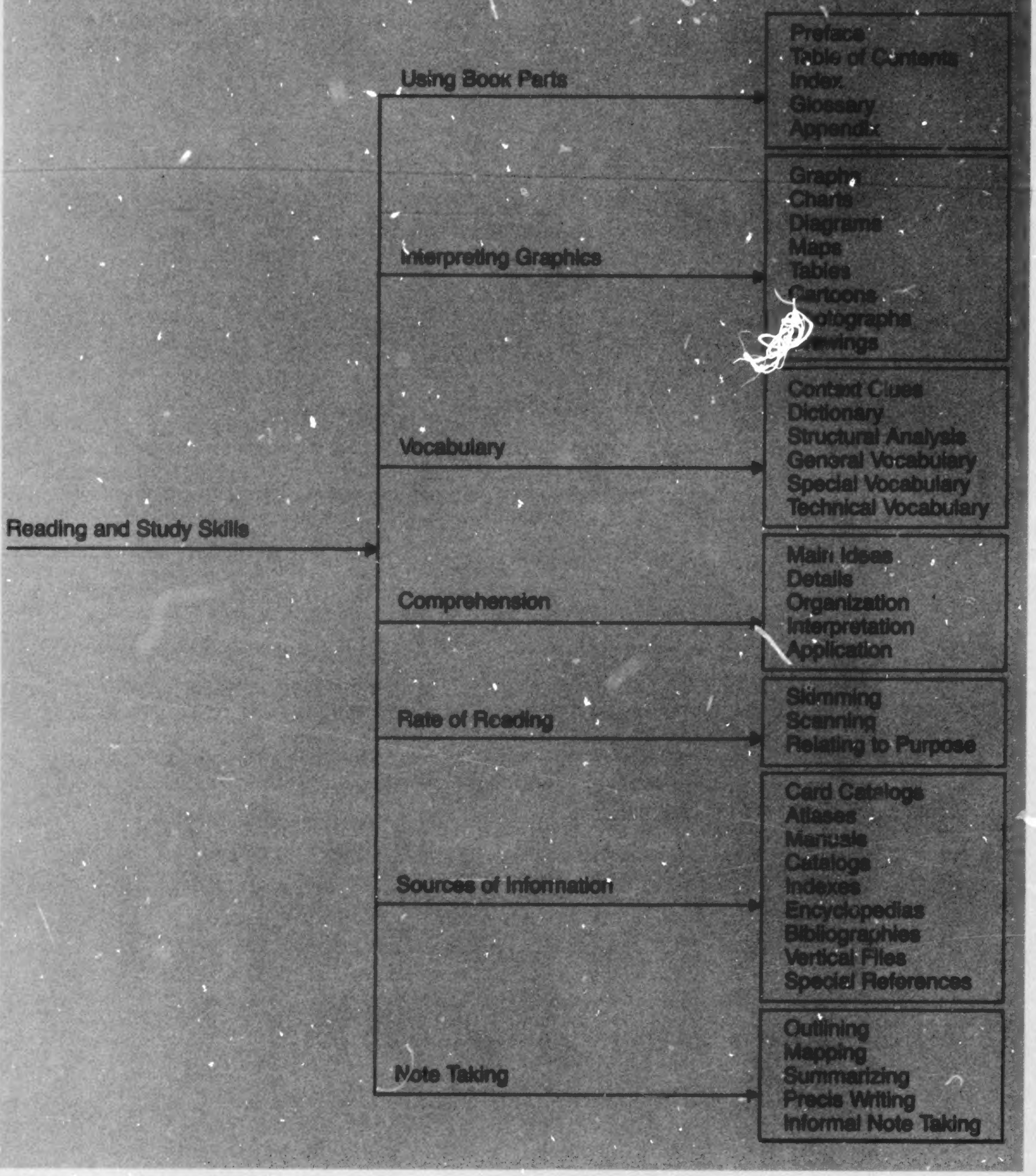
If one of your students is working with a reading specialist, there are ways in which you can be helpful. You can supply the specialist with a list of occupational terms that he or she could use in developing vocabulary exercises. You can provide textbooks and other materials that might be used in that student's reading program. In your demonstrations, illustrated talks, and class assignments, you could incorporate some of the reading skills being worked on in the remedial program.

The Reading Process

To make the complex process of reading easier to understand, it is often described in terms of skills. Sample 1 provides an overview of the reading and study skills that you can extend and develop in the course of your instruction.

SAMPLE 1

READING AND STUDY SKILLS


Reading and Study Skills
Using Book Parts
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Informal Note Taking

As shown in the sample, there are seven categories of skills: using book parts, interpreting graphics, vocabulary, comprehension, rate of reading, sources of information, and note taking. Each of the categories is broken down into a number of topics further defining the skill areas; these are indicated by the words in the boxes. These are the skill areas and topics you may need to address in your classroom and lab.

Three of the categories—interpreting graphics, vocabulary, and comprehension—have been identified as essential to students in vocational-technical programs, and these are emphasized in this module. However, you may want to select any of the skill areas that are particularly necessary or appropriate for the occupational area in which you teach. The chart, then, can be used to help you plan your reading program.

Optional Activity 2

For further information about the reading process and your role in the teaching of reading, you may wish to read the following supplementary reference: Herber, *Teaching Reading in Content Areas*, pp. 1–36.

Optional Activity [illegible]

For further information about how you might improve your own reading skills, you may wish to arrange through your resource person to meet with a reading specialist who can assess your reading performance and suggest materials and/or programs through which you can improve your skills, if necessary.

Optional Activity 4

For information on how to construct an informal reading test using your own vocational-technical instructional materials, you may wish to read the following supplementary reference: Schwartz, "Can Your Students Read Their Textbooks?" *Florida Vocational Journal.* This article describes the procedures for developing a "maze test" based on materials from your own occupational program.

Activity 5

The following items check your comprehension of the material in the information sheet, Technical Reading in Vocational Programs, pp. 9-14. Each of the four items requires a short essay-type response. Please explain fully, but briefly.

SELF-CHECK

1. Why is it important that all teachers in all content areas gain competence in the teaching of technical reading skills?

2. Explain the difference between a reading specialist's approach and purpose in teaching reading, and that of a vocational-technical instructor.

3. What are some of the ways by which the teaching of technical reading skills can be incorporated within a vocational program?

4. Assume that you have met a vocational-technical instructor who says she isn't interested in her students' reading abilities. Her students, she claims, should have learned to read long before they reached her program. She feels that, if students have trouble reading the materials in her program, it is a problem they must solve on their own. What could you say to this instructor to try to convince her that her views are mistaken?

Feedback 6

Compare your written responses to the self-check items with the model answers given below. Your responses need not exactly duplicate the model answers; however, you should have covered the same **major** points.

MODEL ANSWERS

1. Teaching technical reading skills in all content areas is important because each subject may have different reading requirements. Each may have its own vocabulary, distinctive requirements for comprehension, and unique materials.

   Students are taught only beginning-level reading skills in the elementary schools. As they move through the curriculum, they must be taught how to extend these skills to read the specialized materials in each new subject. The teachers of the various content areas are experts in their subjects and, therefore, are best prepared to help students learn how to read their particular materials.

2. A reading specialist's primary job is to teach students who have severe reading problems and who need help in acquiring basic reading skills. The approach used is first to assess the students' reading abilities to determine where their weaknesses lie and then to find appropriate materials with which to remediate those weaknesses.

   A vocational-technical instructor's purpose in teaching reading is to help all students in the program to develop the skills they need to read the technical materials that are part of that program. The approach used is first to analyze the materials to determine what skills are required in order to read, understand, and apply the information. Then the instructor can help students adapt reading skills they may already have or develop new ones, as required by the materials.

   Some occupations (e.g., tool and die making) require that workers be able to read complex tables. Other occupations (e.g., nursing) require that practitioners know a great many difficult technical terms. Vocational-technical instructors must plan to teach the specific technical reading skills that students in their programs must have in order to succeed.

3. The teaching of technical reading skills might take place in any part of the vocational program and at any time. It is not set aside as a special activity conducted at some specific time (e.g., a 30-minute session each Friday afternoon). The teaching of reading should be incorporated within the teaching of occupational skills or in related lessons.

   Vocational teachers can introduce the meaning of new technical terms during a clsss discussion. They can have students practice reading step-by-step instructions as part of project work. They can set up exercises in which students must find technical information by using the index of their textbook.

   This kind of approach to reading can, of course, help students with their present studies. Equally important, it can help prepare them for the future, when they will need to continue to update their occupational knowledge and skills.

4. Vocational-technical instructors have a fine reputation for being concerned about the needs of the students in their programs. This instructor needs to consider that students' reading needs should be no exception. Knowing each individual's reading level, reading strengths, or special problems allows an instructor to adapt the program to meet student needs.

   The adaptation might be something as basic as changing the textbook so that it is at the right level of difficulty for most of the students. It might be something as personal as working with one or two students to increase their technical vocabulary. This instructor can do this only if she has information about students' reading skills.

   She also needs to understand how important it is for her to work cooperatively with reading specialists. Students who have severe problems need to be referred to such staff for remedial assistance. Reading deficiencies are likely to be obstacles to success throughout a student's life. Thus, this instructor has a responsibility to be a part of the schoolwide effort to assist students in removing those obstacles.

Level of Performance: Your written responses to the self-check items should have covered the same **major** points as the model answers. If you missed some points or have questions about any additional points you made, review the material in the information sheet, Technical Reading in Vocational Programs, pp. 9–14, or check with your resource person if necessary.

Learning Experience II

OVERVIEW

Enabling Objective

After completing the required reading, develop vocabulary exercises based on vocational instructional materials.

Activity 1

You will be reading the information sheet, Developing Vocabulary Exercises, pp. 20–33.

Activity 2

You will be developing vocabulary exercises based on an analysis of technical and specialized vocabulary selected from instructional materials used in your own occupational specialty.

Feedback 3

Your competency in developing vocabulary exercises will be assessed by your resource person, using the Vocabulary Exercises Checklist, p. 37.

Activity
1

An understanding of specialized and technical vocabulary is essential for students in every vocational-technical program. Without the necessary vocabulary skills, your students will likely have difficulty succeeding in their chosen occupations. For information concerning the importance of vocabulary skills and the practical procedures to be followed in developing vocabulary exercises, read the following information sheet.

DEVELOPING VOCABULARY EXERCISES

Each occupational area has its own language. Before students can comprehend the "plain sense" of the instructional materials they are to read, they have to understand the language used. A precise, working understanding of hundreds of difficult terms is often crucial.

For example, not knowing the difference between the terms *boring* and *counterboring* can ruin a project in a woodworking shop. Not knowing the difference between the terms *acorea* (absence of the pupil of the eye) and *acoria* (absence of the sensation of satiety—that is, never feeling one has had enough to eat) could make an amusing medical report, but it could spell tragedy in providing appropriate patient care.

Since knowledge of technical terminology is so important in all vocational-technical programs, vocabulary study should be an integral part of reading assignments. Significant terms are usually associated with (1) the key concepts to be learned, (2) the important processes to be performed, and (3) the tools or instruments to be used. For this reason, the identification of major concepts/processes/tools and key vocabulary words should be an important part of the planning you do to teach reading.

You will probably have little trouble in picking out the words to be taught. You need to look for the following:

- New words that have not appeared in the students' reading previously
- New technical terms
- Complex or compound terms
- Everyday words that have a special meaning in your occupational area
- Key words that students must know in order to understand the particular topic

You also have to decide, based on your knowledge of your students, how many new terms they can reasonably be expected to learn during any given period. Having selected the words, you then must determine how best to teach those words. To do this, you need to know about types of vocabulary skills and the kinds of vocabulary exercises you can use to teach those skills.

Context Clues

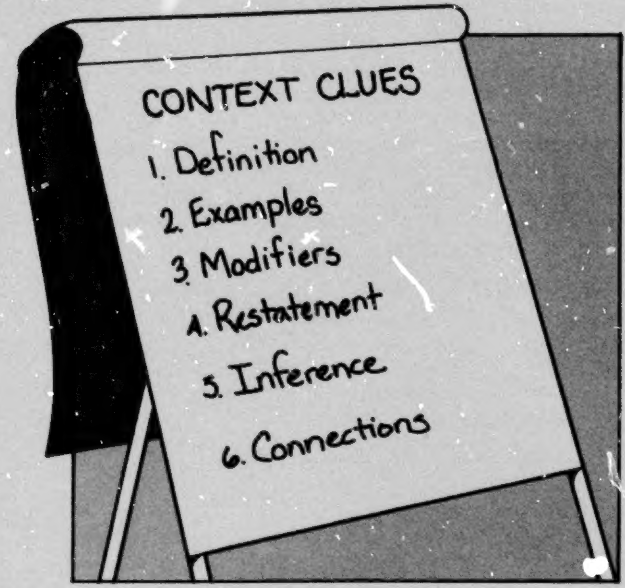
Most reading specialists agree that the single most important vocabulary skill is the use of context clues—the ability to search out a word's meaning from clues given by the other words that surround it. Little children acquire vocabulary in this way—by hearing words used over and over again in similar situations or contexts. Adults continue to learn in this fashion.

For this reason, it may be difficult to give a precise meaning for a word we know. When asked to define a particular word, we may respond, "I can't give you a definition, but I can use it in a sentence." The way in which the word is used in the sentence gives some idea of its meaning—again, through its place in the sentence and the meaning of words preceding and following it.

To use context clues effectively, readers must first recognize the fact that the context **can** provide clues to the meaning of an unknown word. They must also keep in mind that the context may reveal the meaning of a word only partially. In order for the clues to be helpful, they should be near the word, preferably within the same sentence or paragraph.

Types of Context Clues

Context clues can be grouped in six categories: outright definitions,. examples, modifiers, restatement, inference, and inference through established connections. It is not necessarily important that students memorize the label for each of these categories. However, it is important that they know how to recognize each type of clue and understand how each reveals the meaning of a word. The following examples describe how each type of clue works.



Outright definition. This is the easiest context clue to use, since the purpose of the sentence is to give a direct definition. The usual pattern is as follows: the unknown word + a form of the verb *to be* + a definition. For example:

> *Cerebral hemorrhage* is another name for stroke.

In this sentence, the technical term *cerebral hemorrhage* is linked by the word *is*, which is like an equal sign, to the word *stroke*. Rewritten, it could read as follows:

> Cerebral hemorrhage = Stroke

You need to be sure that students recognize the words that are often used as equal signs: *means*, *can be defined as*, *called*, *termed*, and so forth.

Examples. Examples of commonly known things, with which the reader is likely to be familiar, are also frequently used as context clues. They are given to help the reader understand a more general term with which he/she may not be familiar. Signal words (e.g., *like*, *such as*, *for example*) are often used with examples. For instance:

> Many *legume* vegetables, such as navy beans, soybeans, peas, and lentils, can be dried and stored for long periods.

This sentence tells the reader that navy beans, peas, and so on are legume vegetables, helping the reader to understand the possibly unfamiliar term *legume*.

Modifiers. Modifiers may be phrases, clauses, or single words, often in the form of predicate adjectives. They are intended to give a more precise meaning to the word they modify. For example:

> To cut curves in thin wood, one should use a thin-bladed, fine-toothed *scroll saw*.

In this sentence, the phrase *thin-bladed, fine-toothed* modifies, or gives a more precise description of, the term *scroll saw*.

Restatement. A restatement is announced by signal words such as *that is to say*, *that is*, *in other words*, *what this means*, or *to put it another way*. A restatement may also be announced using the word *or*, followed by a synonym. Sometimes dashes or parentheses indicate a restatement. For example:

> Agglutinins are chemicals that *agglutinate* cells—that is, make them stick together in clumps.

In this example, the restatement tells us that the word *agglutinate* means to make something stick together.

Inference. Inference is the process of gathering details and "reading between the lines" in order to perceive relationships that have not been explicitly stated. In other words, no signal words are present to connect the term with an explanation of its meaning. However, by using reason, logic, and speculation (in short, inference) you can deduce such an explanation. For example:

> The welding operation should be shielded so that no one in the vicinity may be in a position to look directly at the arc or have it shine in his/her eyes. If someone should accidently become severely *flashed*, special treatment should be given at once by a physician.

In this case, the meaning of the word *flashed* can be inferred from two clues. One: The first sentence shows that it has to do with looking directly at the extremely bright light of the welding arc. Two: The fact that a person looking at an arc may need treatment by a physician is an obvious clue that being flashed is hazardous and can cause severe eye damage.

Inference through established connections. This context clue depends on relationships established by sentence construction—repetition of key words or the use of connecting words that indicate comparison or contrast. For example:

> What lay people call "strokes" or "apoplexy," physicians call "cerebrovascular accidents."
>
> Teak wood has many of the same uses as black walnut but is harder to work, lighter in color, and close-grained and oily rather than open-grained.

In the first example, the common terms and the technical terms are linked by key words: "What lay people call . . . physicians call. . . ." In the second example, connecting words indicate how teak contrasts with black walnut: ". . . *but* is harder . . . lighter . . . close-grained and oily *rather than* open-grained."

Context Clues Exercises

You can design exercises to help students develop skill in using context clues. First, you should review the materials to be read and pick out examples of sentences in which the meanings of special or technical words are revealed using the different types of context clues.

Next, you need to copy each sentence, underlining or otherwise highlighting the word to be defined. (In this module, for example, the words to be defined are printed in italics.) Then you can design a step-by-step procedure to guide students in analyzing each sentence to determine the meaning of the unknown word. The following is an example of such a procedure:

1. Ask students to identify any signal words in order to determine what kind of information the context is providing.
2. Ask students to point out the clue section of the sentence.
3. Ask students to analyze the clue section to identify possible meanings of the unknown word.
4. List some possible meanings from which the students can select the best or correct meaning.

This procedure may, of course, be carried out as a class discussion, as well as in the form of a series of written questions to be answered.

One caution, however. You should not simply provide a list of sentences, each with the unknown word highlighted and a multiple choice of possible definitions to choose from. You must also provide a step-by-step analysis procedure. If you do not, you will simply be testing students, not guiding them.

In producing a written exercise, you will need to attend to certain routine matters. Directions to the student must be brief but very clear and easy to follow. (You can pilot test this with one or two students to see whether they have any trouble.)

Furthermore, the exercise itself must be free of mistakes (e.g., spelling, punctuation, or typographical errors). Finally, the duplication process should produce copy that is easy to read and attractive. For variety, different paper colors (other than white) could be used.

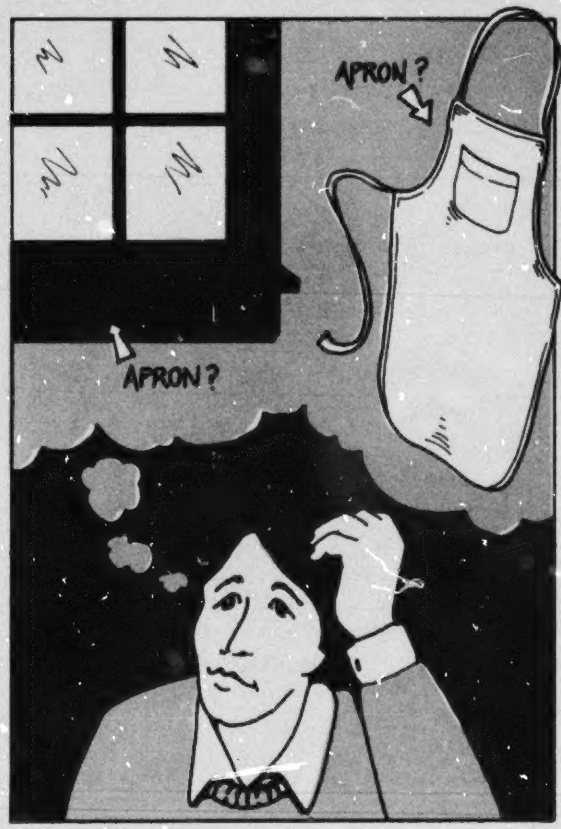
Sample 2 shows an example of one type of context clues exercise. (The answer keys provided in this and other samples in the module are for your use, should you wish to try to complete the exercises yourself.)

Context Clues in Specialized Vocabulary

Context clues are often essential in finding the meanings of specialized vocabulary words. Specialized words are those words that have common general meanings, but that have different and highly specific meanings when used in a given subject area.

Consider the word *radical*, for example. To a nursing instructor, radical surgery means the most extensive surgery available for the condition. To a mathematics teacher, radical pertains to a root. To a social studies teacher, it means favoring drastic political or social ideas.

There are many such specialized words in vocational education. In auto mechanics, the following are examples of everyday words with specialized meanings: *bleeding*, *bounce*, *shimmy*, *race*, and *tramp*. In machine shop, such ordinary words as *backlash*, *female*, *journal*, and *worm* take on special meanings. Sample 3 shows some words that take on special meanings when used in carpentry.


APRON ?
APRON ?

SAMPLE 2

CONTEXT CLUES EXERCISE

Vocational Program: Food Services

Directions: In reading technical materials, it helps to know how to search out the meanings of new wo from clues given in the sentence. Read the sentence that follows, and then answer the questions at Circle the best responses to items 1–5. Write out your response to item 6.

> Many *legume* vegetables, such as navy beans, soybeans, peas, and lentils, can be dried and stored for long periods.

1. What word are we trying to define?
   a. lemur b. lugubrious c. legume
2. What words in the sentence signal you that some information will follow to tell you about legumes?
   a. vegetables b. such as c. can be
3. What kind of information do you expect to follow this signal?
   a. opposites b. examples c. [illegible]
4. According to this sentence, what do navy beans, soybeans, peas, and lentils have in common?
   a. They are legumes. b. They are small. c. They
5. What might be another kind of legume vegetable?
   a. hominy b. popcorn c. pinto beans
6. If you work in food services, what does this sentence tell you about storing navy beans? ______________

Answer Key: (1) c; (2) b; (3) b; (4) a; (5) c; (6) They can be dried and stored for a long time.

SAMPLE 3

EVERYDAY WORDS WITH SPECIALIZED OCCUPATIONAL MEANINGS

	General Meaning	Carpentry Meaning
Apron	A garment used to protect clothing	A flat piece of window trim underneath the sill
Hip	The projecting part of the body formed by the side of the pelvis	Two adjacent sloping sides of a roof
Sleeper	A person who is asleep	A heavy horizontal timber
Valley	A long, low area between hills or mountains	The angle formed by the meeting of tw inclined sides of a roof
Run	To go quickly by moving the legs	The horizontal distance of a step or stairway
Ground	Earth or soil	Strip of wood used as a stop for plaster

Since students may already know the general meanings of such words, you must be sure that they understand the special ways in which these words are used in the occupation. Sample 4 shows one way to design an exercise for this purpose.

There are a variety of other approaches you can use to help students identify the special ways words are used in the occupation. For example, you might ask them to derive the meaning from context clues. Or you could ask them to refer to a dictionary or glossary for help.

Depending on the age level and sophistication of your students and the complexity of the specialized vocabulary in your occupational area, you may not need to devote an exercise to this. A straightforward handout—presenting each word, its general meaning, and its specialized meaning—may suffice.

In sample 3, the specialized uses of words in carpentry become obvious when compared with other meanings. However, unless you make these differences obvious, students may not realize that the terms are special—that they are used by other occupations, professions, or the general public in different ways.

Structural Analysis

Another important way to unlock the approximate meanings of words is by structural analysis, or studying the word parts. Some words can be divided into parts called roots, prefixes, and suffixes. A **root** is the base or fundamental part of a word (e.g., *port*, which means "to carry"). A root can often stand alone as a word. Some words, by the way, are composed of two roots.

A **prefix** is a letter or sequence of letters that comes before a root, as in the word ***transport***. Its function is to change or modify the meaning of the root. *Trans* is a Latin prefix meaning "across." Thus, *transport* means to carry across. *Ex* is a Latin prefix meaning "out of." Thus, *export* means to carry out of.

A **suffix** comes after the root. A suffix may entirely change the meaning of a word, but its usual function is to change the part of speech of the base word. For example:

trans + port + *ed* = past tense of the verb *transport*

trans + port + *ation* = noun; the act of transporting

trans + port + *able* = adjective; capable of being transported

trans + port + *er* = noun; one who transports

Prefixes and suffixes are not usually derived from English words. Rather, they derive from other languages, such as Latin or Greek. A good dictionary is a great help in analyzing words, because it gives the meanings of prefixes and suffixes as well as whole words.

A knowledge of prefixes and suffixes is extremely helpful in figuring out the meanings of new words. Knowledge of such prefixes as *auto-*, *bio-*, *hydro-*, *lith-*, *photo-*, *pneumo-*, and others can reveal the meanings of hundreds of words, including the technical terms used in various occupational programs. Understanding such common suffixes as *-ability*, *-meter*, *-ology*, and *-chrome* can unlock the meanings of hundreds more.

Allied health program materials, for instance, contain hundreds of terms that can be difficult to learn. However, mastering these terms can be simplified to a great extent if students know how to dissect the words and analyze their parts.

For example, the root *cyto* means cell. Most prefixes attached to this root word describe the cell in some way: ***erythrocyte*** means red blood cell; ***leukocyte*** means white blood cell. Suffixes give other information about the cell: *cyto**genesis*** is the beginning or development of cells; *cyto**logy*** is the study of cells.

Sample 5 shows how the process of word analysis can be used to derive the meaning of words drawn from various other technical fields. As can be seen in this sample, there are limitations to the use of structural analysis. When a word is broken into its parts, and each part is defined with its Greek or Latin meaning, the result will be a literal translation. This may be quite different from the actual meaning of the word.

For example, *photography* = photo + graph = light writing. While this analysis does hint at the process of photography, it is only a hint.

SAMPLE 4

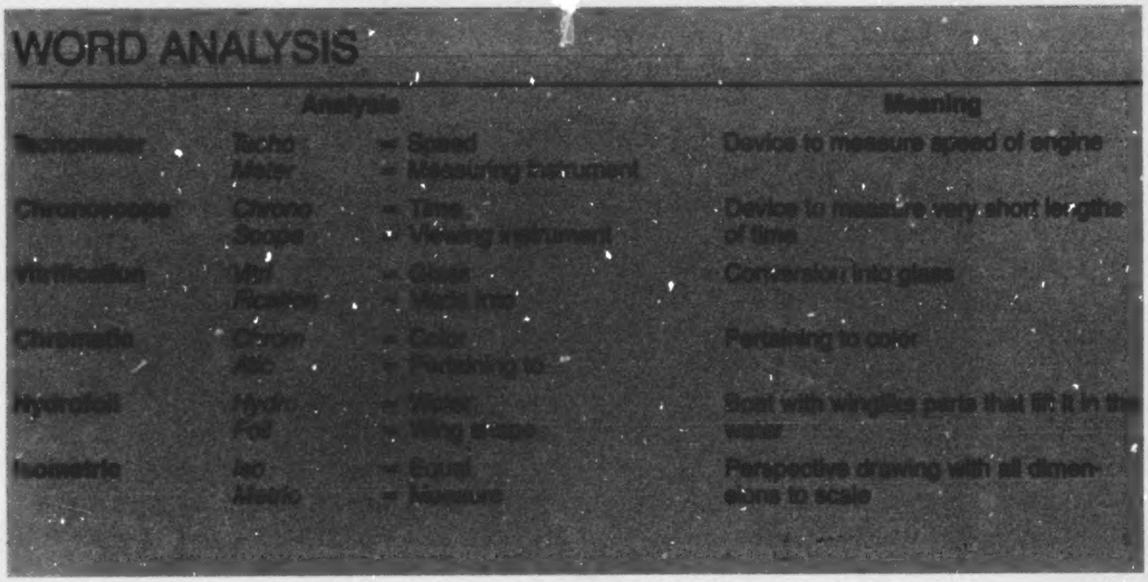
CONTEXT CLUES EXERCISE FOR SPECIALIZED VOCABULARY

[illegible]

1. APRON
   - a. The blacksmith's leather apron was full of holes [illegible]
   - b. The pilot tied down the wings of the aircraft on the apron [illegible] in case of high wind.
   - c. The contractor inspected all the aprons, [illegible] until they be replaced and repaired.
2. GROUNDS
   - a. The wife felt she had grounds for divorce.
   - b. The grounds of the school are full of weeds and [illegible]
   - c. Before the plaster can be applied, [illegible] room.
3. TRIM
   - a. If the aircraft is in proper trim, it will be balanced [illegible]
   - b. The fine mahogany wainscoting on the walls is the last trim [illegible] room.
   - c. Jogging three miles before breakfast can help keep you fit and trim.

Answer Key: (1) Apron: a. A piece of clothing; b. An aircraft parking area near the hangars; c. (✓) A place [illegible] (2) Grounds: a. Cause or reason; b. The area surrounding the school; c. (✓) [illegible] (3) Trim: a. The position of the plane in the air; b. (✓) High- [illegible] c. Something that is neat and compact.

SAMPLE 5



WORD ANALYSIS

	Analysis		Meaning
Tachometer	Tacho Meter	= Speed = Measuring instrument	Device to measure speed of engine
Chronoscope	Chrono Scope	= Time = Viewing instrument	Device to measure very short lengths of time
Vitrification	*Vitri* *Fication*	= Glass = Made into	Conversion into glass
Chromatic	Chrom Atic	= Color = Pertaining to	Pertaining to color
Hydrofoil	Hydro Foil	= Water = Wing shape	Boat with winglike parts that lift it in the water
Isometric	Iso Metric	= Equal = Measure	Perspective drawing with all dimensions to scale

Such an oblique hint might be confusing if students were trying to figure out the meaning of a totally unknown word. In cases like that, students may first need to be taught the definition of the new word. Then, they could use their knowledge of word parts (1) to help them grasp the meaning of the word, and (2) as a device for **remembering** the meaning of the word. In that way, technical terms should begin to make a lot more sense to them.

Another problem with structural analysis is that some prefixes have two or more, often unrelated, meanings. For example, *in-* means "not" in such words as *indirect*; it means "into" in such words as *incision.*

A third problem with structural analysis is that the initial letters in some words look like prefixes when they aren't, as in the words *equipage* and *equine. Equi* is not a prefix meaning "equal" in these words.

Despite these limitations, structural analysis can be a useful method for figuring out word meanings. This skill, like that of using context clues, involves a problem-solving approach to word study.

Structural Analysis Exercises

As with any other reading skill, you can help your students develop skill in analyzing word parts. Therefore, when you review program materials to prepare your instructional plans, you should note vocabulary words that lend themselves to structural analysis and then develop appropriate exercises.

You should avoid simply giving a list of prefixes and suffixes for students to memorize—although ultimately you will want them to memorize the ones common to their occupational field. The exercise shown in sample 6 illustrates one approach to the teaching of word parts.

SAMPLE 6

WORD PARTS EXERCISE

Vocational Area: Health Occupations

Directions: Clues to the meanings of many [illegible] Part 1 the meanings of a number of [illegible] each word listed in Part 2. Do the following:

- Find clues to the meaning of the word by [illegible] (sometimes omitted when combining word parts [illegible] ciation.)
- Write your literal translation of the word [illegible]
- Look up the actual definition of the word in a [illegible]
- Write the dictionary definition next to [illegible]
- Compare the two definitions of the word [illegible]

Part 1:

Prefixes

erythro- = red
leuko- = white
a- or an- = without, deficient
phage- = eat
endo- = inside, within
peri- = around
tri- = three
bi- = two, double
semi- = half

[illegible]

Part 2:

Technical Term	Literal Translation	Actual Definition
1. erythrocyte (erythro + cyto)	Red cell	Red blood cell
2. leukocyte (leuko + cyto)	White cell	A white or colorless nucleated cell [illegible] in the blood
3. leukocytosis (leuko + cyto + osis)	Condition of white cells	An increase in the number of leukocytes in the circulating blood
4. leukopenia (leuko + penia)	Decrease [illegible]	A condition in which the number of [illegible] circulating in the blood is [illegible]
5. anemia (an + emia)	Deficient blood	A condition in which the blood is deficient in red blood cells, in hemoglobin, or in total volume
6. phagocyte (phage + cyto)	Eat cell	A cell that characteristically engulfs foreign matter and consumes debris and foreign bodies

7. phagocytosis (phago + cyto + osis)	Diseased condition of eat cells	The engulfing and usually the destruction of particulate matter by phagocytes
8. thrombosis (thrombo + osis)	Clot disease	The formation of a blood clot within a blood vessel during life
9. myocardium (myo + cardio)	Heart muscle	The middle muscular layer of heart wall
10. endocardium (endo + cardio)	Inside heart	A thin serous membrane lining the cavities of the heart
11. pericardium (peri + cardio)	Around heart	The conical sac of serous membrane that encloses the heart and the roots of the great blood vessels of vertebrates
12. hemolysis (hemo + lysis)	[illegible]	Liberation of hemoglobin from red blood cells
13. bicuspid (bi + cusp)	[illegible]	Having or ending in two points, as a human premolar tooth
14. tricuspid (tri + cusp)	[illegible]	Having three points (as a cusp) [illegible]
15. semilunar (semi + lunar)	Half - moon	Shaped like a crescent [illegible] the heart and aorta

Oral Vocabulary Instruction

Not all exercises need to be written. Much of your vocabulary instruction can occur during the discussion of reading assignments. Often, through discussion, students can be led to **organize** the knowledge that they already have about words in order to discover the meaning of a new word.

For instance, the term *traction* is found in a number of different occupational programs. After writing the word on the board, you could ask if someone sees a smaller, familiar root word within the new word—in this case, *tract*. Next, you can ask students to identify other words that have *tract* as a root or base, and you can list those words as students think of them. For example:

tractor
attract
detract
subtract
protractor
distraction
contract
contractor
extract

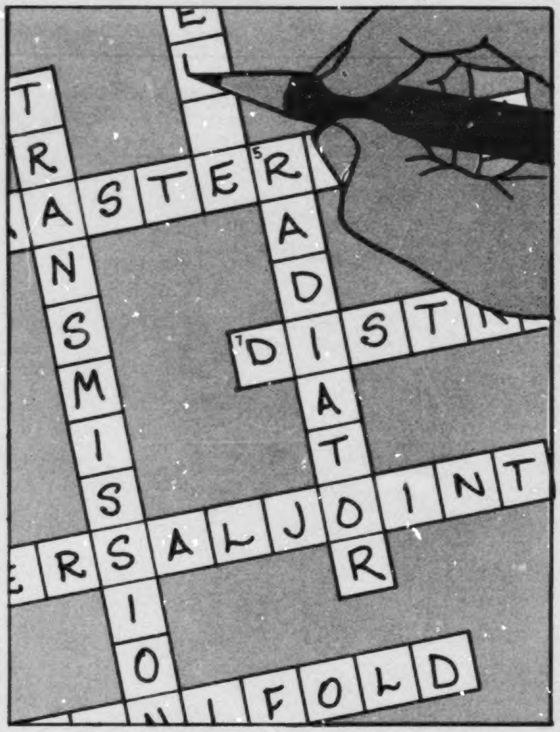
Then, you can ask students to analyze the meanings of these words. What does a tractor do? It pulls things. *Tract* + *or* = pulls + something or someone. The other words can be analyzed in the same manner.

at + *tract* = pulls toward
de + *tract* = pulls away
ex + *tract* = pulls out
con + *tract* = pulls together or with

To get back to the key word, *traction* can then be translated as "the act of pulling." From this brief discussion, you will not only have taught a "new" word, you will also have helped students to see relationships they may never have seen before between new words and other words they already know.

By helping students form a pattern of past knowledge, you help them to create a place—a context—for the new knowledge. Whenever they see another new word that has the root *tract* in it, they can immediately associate it with all the others they know. As a result, they probably will be able to figure out its meaning. Opportunities for this type of word study present themselves almost daily.

Word Puzzles and Games



Vocabulary exercises involving word puzzles and games can also be used to teach students new words and their meanings. In addition, they can help students **review** the meanings of words they have already learned. Students tend to enjoy word games.

The following are some word puzzles and games you can devise:

- Hidden word puzzles (several rows of letters in which words are hidden vertically, horizontally, and diagonally)
- Word scrambles (scrambled letters to be rearranged to form words, often with the definitions given as clues)
- Crossword puzzles
- Anagrams (words to be rearranged to form new words)
- Simple acrostics (lists of words in which sets of letters—e.g., the first or last in each word—form a word or phrase)
- Analogies (two pairs of words with similar relationships, in which one pair is complete and one has a word missing; the word must be supplied by determining its relationship to the other word in the pair)

A simple acrostic and a set of analogies are illustrated in samples 7 and 8.

You won't want to use word games all the time, but on occasion they can be useful—for example, when a student has finished one activity but does not have time to start the next one. Word games can be used to add variety to your instruction. A word game can even be used as part of a written test, if students are given sufficient time to complete it. Ideas for games of this type may often be found in professional magazines devoted to your vocational-technical area.

SAMPLE 7

SIMPLE ACROSTIC EXERCISE

[illegible]

[illegible] to form the words [illegible]

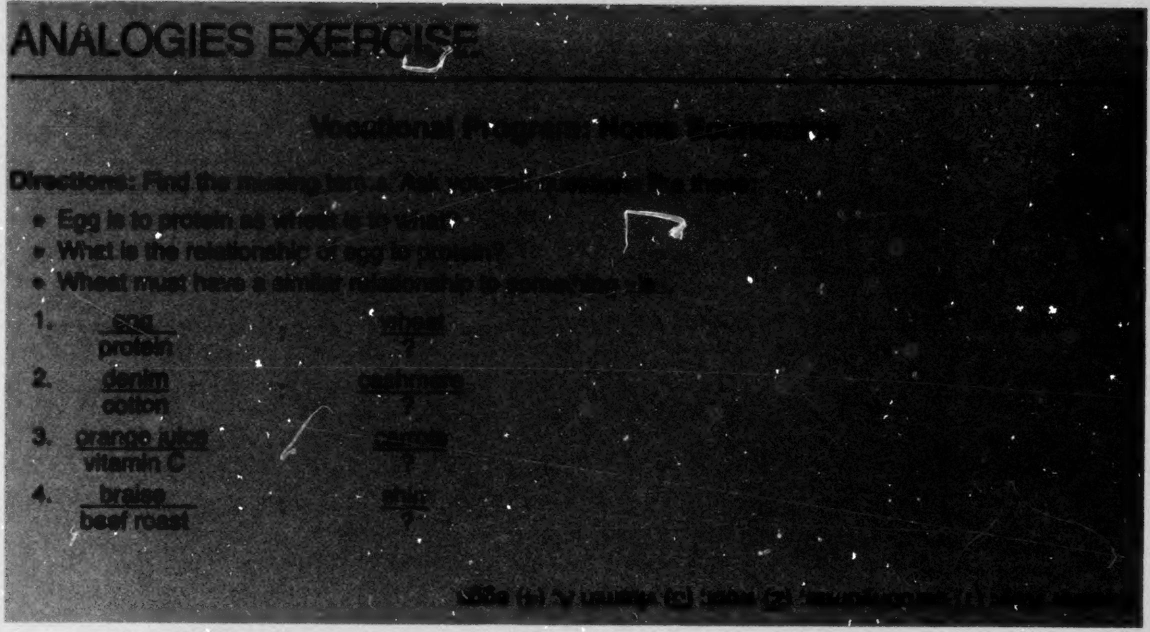
1. A [illegible] is introduced and ignited
2. The [illegible]
3. [illegible]
4. [illegible]
5. The [illegible]
6. The [illegible]
7. A [illegible]
8. The [illegible]
9. A [illegible]
10. A [illegible]
11. An [illegible]
12. A [illegible]
13. The [illegible]

Part 2: Answers

8. _ _ E _
9. _ N _ _ _ _ _ _
10. _ _ _ _ G _
11. _ _ _ I _ _ _ _ _ _
12. _ _ _ _ _ _ N _ _
13. _ E _ _ _

Answer Key: (1) Afterburner; (2) Thrust; (3) Screech; (4) Subsonic; (5) Ignitor; (6) Density; (7) Creep; (8) Inlet; (9) Nozzle; (10) Surge; (11) Efficiency; (12) Governor; (13) Newton

SAMPLE 8



ANALOGIES EXERCISE

Vocational Program: Home Economics

Directions: Find the missing term. Ask yourself questions like these:

- Egg is to protein as wheat is to what?
- What is the relationship of egg to protein?
- Wheat must have a similar relationship to something—is...

1. egg / protein — wheat / ?
2. denim / cotton — cashmere / ?
3. orange juice / vitamin C — carrots / ?
4. braise / beef roast — shirr / ?

[illegible] (1) [illegible]; (2) wool; (3) vitamin A; (4) eggs

Analyzing Vocabulary

As mentioned previously, the first step in developing vocabulary exercises is to carefully read the materials you are going to assign. As you read, you can identify the technical and special words you feel are essential to an understanding of the information. After you have made a list of those words and analyzed how they are presented in the materials, you then need to determine how to teach them.

Are the words in sentences that provide context clues as an aid to discovering their meaning? Is there a drawing, cartoon, or picture of some sort that might illustrate the meaning in some way? Does the term lend itself to structural analysis? In other words, are there key suffixes, or other word parts involved?

If none of these methods apply, is the term defined in the glossary of the text? Sometimes, none of these aids are available. At other times, more than one will be present. You will have to decide on the most efficient method to use.

The vocabulary analysis chart shown in sample 9 provides a useful format for analyzing instructional materials for vocabulary difficulties. Since this should be done for each reading assignment, you may wish to duplicate copies of such a chart for use on a regular basis. You should use the following steps to guide your use of the chart:

1. Review the text chapter or other assigned reading and select the new vocabulary words you wish to teach.
2. Analyze the text to determine how the words are used or explained there.
3. Decide what strategies might be best to use in teaching the words to your students.
4. Note what you must do to prepare for the learning activity.

SAMPLE 9

Activity 2

Using instructional materials from your own occupational specialty, find examples of technical and specialized vocabulary words. Select at least ten words and list them in the right-hand column of the Vocabulary Analysis Chart, p. 35.

Next, complete the analysis chart, determining (1) how each word is used in the text and, thus (2) which would be the most efficient vocabulary exercise(s) to use.

Then, using the same ten words, prepare at least two of the following three types of written exercises to develop students' vocabulary skills:

- Context clues exercise
- Structural analysis exercise
- Word puzzle or game

Your choice of exercises will also be affected by their applicability to your occupational area.

For example, instructors in health occupations and agriculture might choose structural analysis, because combined words and words constructed of identifiable word parts are used frequently in these fields.

Those in T&I and home economics, on the other hand, may choose context clues, because so much of the terminology in these fields can be related to commonly known words.

You may use the formats of the sample exercises provided in the information sheet, Developing Vocabulary Exercises, pp. 20–33, as models.

Feedback 3

After you have completed your vocabulary exercises, arrange to have your resource person review and evaluate your exercises. Give him/her the Vocabulary Exercises Checklist, p. 37, to use in evaluating your work.

SAMPLE 14

[illegible] EXERCISE: TIME SEQUENCE

[illegible] Carpentry

[illegible] in writing to the two items.

[illegible] build or install stairs and built-in cab[illegible] After that, they trim the house inside and out. [illegible] Finally, they take care of hundreds of details to com[illegible] the house and make it ready for occupancy.

1. [illegible] different phases of construction in which carpenters are in[illegible]
2. [illegible] things carpenters do during the construction of a house. They are in jumbled [illegible] (1, 2, 3, 4, 5) in the proper sequence, using the space provided beside each step.

_______ Build stairs

_______ Construct framework

_______ Take care of hundreds of final details

_______ Build roof

_______ Trim house

Answer Key: (1) Initially, Then, Later, After that, Finally; (2) 3, 1, 5, 2, 4

Vocabulary Analysis Chart

Title of Materials: ______________________ Name: ______________________

Section Analyzed: ______________________ Date: ______________________

	Use in Text			Most Efficient Vocabulary Exercise					
Vocabulary Words	Defined and/or explained through context clues	Illustrated	Key word parts involved	Use of context clues	Structural analysis	Dictionary or glossary	Teacher demonstration	Puzzle or game	

NOTES

VOCABULARY EXERCISES CHECKLIST

Directions: Place an X in the NO, PARTIAL, or FULL box to indicate that each of the following performance components was not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, a performance component was not applicable, or impossible to execute, place an X in the N/A box.

Name

Date

Resource Person

	LEVEL OF PERFORMANCE			
	N/A	No	Partial	Full
In preparing the vocabulary exercises, the teacher:				
1. listed ten appropriate specialized and technical terms found within the instructional materials	☐	☐	☐	
2. analyzed the materials to determine how each word was used (i.e., whether it could be defined through context clues or key word parts)	☐	☐	☐	
3. selected two exercises for teaching or reviewing the terms, which were appropriate based on the analysis made	☐	☐	☐	
The vocabulary exercises developed by the teacher:				
4. were pitched at the right level for the intended audience	☐	☐	☐	
5. included all the information the students needed in order to learn the terms	☐	☐	☐	
6. included clear directions	☐	☐	☐	
7. were technically well produced:				
a. free of errors	☐	☐	☐	
b. easy to read	☐	☐	☐	
c. attractive	☐	☐	☐	

Level of Performance: All items must receive FULL or N/A responses. If any item receives a NO or PARTIAL response, review the material in the information sheet, Developing Vocabulary Exercises, pp. 20–33, revise your exercises accordingly, or check with your resource person if necessary.

NOTES

Learning Experience III

OVERVIEW

Enabling Objective

[illegible]

[illegible]

[illegible]

[illegible]

Activity

1

To read without comprehending is rather like eating without digesting—neither accomplishes its purpose. For information concerning the need for comprehension skills, as well as practical procedures to be followed in developing comprehension exercises, read the following information sheet.

DEVELOPING COMPREHENSION SKILLS

Understanding what you read while you are reading it—that's comprehension. Reading is the process of translating symbols into ideas. It sounds simple, but it is a complex process. There are a number of abilities involved in reading, including those that follow.

Ability to understand graphic symbols. This means students must be able to make sense out of the little black letters printed on a page. In addition, they must be able to understand the meaning of lines, numerals, and drawings on a chart or diagram. Vocational-technical subjects are loaded with symbols that students must understand in order to complete a task.

Ability to react to sense images (sight, sound, taste, touch, and smell) suggested by words. While reading a description of a plant, for example, a horticulture student should be able to form a mental picture of the healthy plant, the color and the smell of its blossoms, the texture of its leaves, and the taste of its fruit.

Ability to perceive relationships. Students must be able to distinguish between cause and effect, general and specific, whole and part, smaller and larger. In many occupational areas, it is particularly important to understand time and sequence (e.g., what must happen first, second, and third in a critical nursing procedure).

Ability to follow directions. Vocational-technical students must be able to read a series of instructions and then take a course of action. Sometimes the directions are complex, and most times there is little room for error. Therefore, words must not be misunderstood, and parts cannot be overlooked. The skill of following directions does not come naturally; it must be learned.

Ability to understand written units of increasing size. Students need to understand not only the meanings of individual words, but how they are used in phrases, sentences, and paragraphs. As the written unit gets larger, the difficulties of comprehension tend to increase. You may need to help students read a whole paragraph or book section, for example, to get the most out of it.

Ability to make inferences and draw conclusions. This means that students must go beyond the facts presented in the reading and try to anticipate the results or effects that might follow. It is a simple matter, for example, for a retailing student to read that the price of copper has gone up dramatically. It is much more difficult for the student to determine what that means in terms of the sale of electrical appliances or the design of plumbing supplies.

There are a number of other abilities that are involved in reading comprehension, but the ones cited give some idea of their variety and complexity. You need to understand the problems that students face in comprehending technical materials and to ensure that students possess the skills needed.

Teaching comprehension skills does not necessarily require that you develop special activities or exercises, however. For the most part, these skills can be taught or improved through brief comments, questions, or directions provided during the usual course of instruction.

Levels of Comprehension

There are three levels of comprehension: literal, interpretive, and applied. *Literal* means word-for-word. At the **literal level** of comprehension, therefore, one is looking for the exact meaning of the words. To do this, students need to be able to identify the main ideas, spot relevant details, observe sequence, follow directions, and note conclusions.

To interpret means to go beyond what the text actually says to what it really means. Thus, at the **interpretive level** of comprehension, one determines the author's purpose, notices causes and effects that may not have been directly stated, makes inferences, draws conclusions, and so forth. In other words, students need to be able to read between the lines and fill in the gaps left by the author.

At the **applied level,** one uses the information the author has provided to do something—rebuild an engine, construct a porch, give a blood test. Since the ability "to do"—to perform occupational skills—is a primary goal of all vocational-technical programs, developing reading comprehension skills to this level is an absolute necessity.

Reading for Main Ideas and Details

The most basic skill in reading comprehension is the ability to identify the main ideas and important details. This skill is founded upon accurate comprehension of technical terms and phrases, which is why vocabulary development is essential. Without the ability to find main ideas and details, students cannot hope to figure out the author's meaning or recall information in order to apply it to a job or task.

In your program, you might begin work on comprehension with the job sheets (or other written materials) that students will need to use in the laboratory or on the job. You can simply present the material and then ask several questions about it that stress main ideas and details.

Sample 10 shows an automotive job sheet. By using this as a basis, the instructor could ask students (orally or in writing) the following kinds of questions to get at the main ideas presented:

1. What job does this sheet describe?
2. The sheet uses the terms *ignition points*, *breaker points*, and *contact-point assemblies.* What are the differences, if any?
3. Before you begin adjusting the breaker-point gap, what must be done?
4. What does the word *lead* mean when used in the term *condenser lead* or in the term *lead battery*?
5. Why don't you tighten the lock screw as soon as you install the contact-point assembly?
6. What is an eccentric adjustment screw?
7. How do you know the correct gap width for the automobile you are working on?
8. What does this job sheet say about how to get the rubbing block on the high point of the cam?
9. What is the last thing you do before reinstalling the rotor and cap?

You can also help students develop their skills in finding main ideas and details by selecting key paragraphs from other class materials (e.g., textbooks, learning guides, information sheets) and developing questions about them. You should start with relatively simple, straightforward selections. Then you can gradually increase the complexity and difficulty of your selections to include a wide variety of technical materials.

Sample 11 illustrates a comprehension exercise using a fairly simple reading selection and related questions.

Reading for Organization

Most information in textbooks and learning guides is (or should be) presented using basic patterns that stress a relationship among the ideas. In order for students to gain the maximum amount of meaning from their reading, they must be able to recognize the patterns and understand the relationships. Following are descriptions of the basic patterns.

Time sequence. In this pattern, events or procedures are organized in the sequence (or order) in which they take place. It might be an historical sequence. For example:

> The vacuum tube was invented in the early part of the century, transistors were developed later, and recently microprocessor chips have come into use.

This type of pattern is often employed in describing a technical process that takes place over time. For example:

> The heated steel will first have a dull cherry-red color. Then, as heat continues to be applied, it will begin to turn bright red, then orange, and then yellow. Finally, it will turn white and sparks will begin to fly.

SAMPLE 10

SAMPLE 11

1. What is the most important skill to develop to prepare for any job?

2. Data processing positions are [illegible] below, write the [illegible]

Computer [illegible] [illegible]

3. Read this sentence: "Computers [illegible] how to use them."

- Is this sentence [illegible]
- Would you [illegible]
- What, [illegible]

Comparison/contrast. In this pattern, the author may show similarities and differences between concepts with which the reader is already familiar and a new concept. For example:

> A mango has the orange-colored flesh of a peach but is much stronger and spicier in flavor.

Another device used is advantages/disadvantages. And differences in characteristics or purposes can also be used. For example:

> A monkey wrench is a convenient all-purpose tool, whereas an open-end wrench is used where strength and good fit are important.

Sample 12 shows an exercise using comparison/contrast.

SAMPLE 12

COMPARISON/CONTRAST EXERCISE

1. What are the two types of compressor being compared?

   a. axial flow b. centrifugal flow

2. What two types of engine application are they being related to?

   a. small, low-power engines b. large, high-power engines

3. Enter the name of the compressor type and the engine application [illegible] spaces below.

   Compressor type centrifugal flow Engine application [illegible]

   Compressor type axial flow Engine application [illegible]

4. For the two engine applications, [illegible] pressor type and the [illegible]

ENGINE APPLICATION Small, Low-Power		[illegible]	
Centrifugal Flow	Axial Flow	[illegible]	[illegible]
ADVANTAGES	DISADVANTAGES	[illegible]	[illegible]
High pressure rise per stage.	Low pressure rise [illegible]	[illegible]	[illegible]
Good efficiencies over wide speed range	[illegible]	[illegible]	[illegible]
Simplicity and low cost of manufacture	[illegible]	[illegible]	[illegible]
Low weight	[illegible]	[illegible]	[illegible]
Low starting power requirement	[illegible]	[illegible]	[illegible]

BEST COPY AVAILABLE

Cause and effect. This pattern of organization is often used in technical literature that deals with troubleshooting or with adjusting mechanisms. For example:

> Turn the adjustment knob to the right [cause] . . . to increase the height of the flame [effect].
>
> A loud hum [effect] . . . may be the result of a poor ground in the circuit [cause].

Students need to develop skill in spotting and using the cause-and-effect relationship. Sample 13 shows a cause-and-effect exercise from the field of nursing.

Step-by-step procedure. One of the most prevalent organizational patterns used in vocational-technical materials is that of describing technical procedures in a step-by-step sequence. A great many procedures lend themselves to this pattern. However, the written steps are not always clearly labeled *Step 1*, *Step 2*, *Step 3*, and so on. Students may need help in discerning step-by-step instruction, especially when it is obscured in a narrative form. For example:

> It is important to hold the pilot light button down for one minute before lighting the main burner.

SAMPLE 13

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Simple listing. Lists of facts, characteristics, safety precautions, do's and don'ts, and other items are very common in vocational-technical materials. The items on a list may be presented in some specific order (e.g., importance, time), or they may be presented in random order.

Categorization. Grouping things by some shared characteristic is used particularly in descriptive information. For example, in describing woods the categories might be as follows: type of grain (open-grained/close-grained), hardness, texture, color, and so on. Categorization can help the reader deal more effectively with a large number of facts.

Helping Students to Recognize Patterns

Since good writers want to be understood, they use **signal words** to let the reader know what pattern they are using. The emphasis in teaching students to observe paragraph organization, then, is on noting the key words that indicate the patterns being used and seeing relationships among the ideas being presented.

Such words as *first*, *next*, *third*, and *finally* are clues that the author is listing details or steps in a procedure. *By contrast*, *on the other hand*, *however*, and *yet* are signals of comparison/contrast statements. Clues to chronological organization are such words as *initially*, *then*, *soon*, *later*, *after that*, and *at last*.

Directing students' attention to signal words within paragraphs can greatly aid them in reading longer selections, since whole chapters are often organized in this way. Sample 14 illustrates a paragraph organized in terms of time. The author has used clear signal words (e.g., *then*, *later*, *after that*) to indicate this pattern.

You can design some exercises so that, when the exercise is finished, students will have produced a table, flow chart, or some visual representation of the relationship of the ideas presented.

If students can complete a chart such as the one in sample 12 or 13, for example, they will have extracted the most important information and reduced it to a simpler, more usable form. After they have completed the reading and the chart, they can more easily refer to the chart for this important information than if they had to go back and wade through the materials again.

By constructing exercises of this type, you are not only helping students read the materials at hand, but you are also aiding them in note taking—in making their own materials for future reference and review.

Using Questioning Techniques

Students' comprehension skills can also be developed by asking good oral questions or other items in class discussions. Good questioning items should be stated so that students are required to **use** information in responding, not simply to give back information they have been given. Your items should lead students to discover facts, compare and contrast, identify assumptions and opinions, notice cause and effect, analyze, synthesize, draw conclusions, find alternatives, solve problems, illustrate with examples, and so forth.

The list in sample 15 provides examples of questioning items grouped in six categories. The key words, around which you should build your own items, are printed in italics. The examples may help you formulate items in your vocational-technical area on a wide range of cognitive (knowledge) levels. You can use such items in either written exercises or oral discussions.

In addition, most reading assignments in the vocational-technical areas require students to use many reading skills at various levels. Therefore, when reviewing your program materials to prepare reading assignments, you should consider the skills needed to comprehend the materials. You can then prepare exercises or questions to help students develop the skills they need in order to "get" the content. The length, complexity, and type of comprehension exercises will vary according to students' abilities and the content requirements.

The reading comprehension exercises you develop should be very carefully worked out. It is counterproductive, at best, to give students further difficulties in the form of the exercise itself. As you develop these exercises, you should keep in mind the qualities of a good exercise, as follows:

- The directions for completing the exercise should be simple, clear, and brief. The student should not be confused about what he/she is expected to do.
- The nature of the desired response should be clear and unambiguous. Let the student know whether to fill in the blank beside each item with one word, a complete sentence, or a paragraph. If there is a time limit, say so. It is very helpful to "pilot test" your exercise by trying to complete it yourself or, better still, by asking someone else (e.g., a student or colleague) to try it out for you.
- As always, the exercises should be well produced. There must be no errors of grammar, usage, or spelling. The duplicated copy should be easy to read, well laid out, and attractive. The appearance of the exercise should stimulate students' interest, not defy them to figure it out.

SAMPLE 15

EXAMPLES OF QUESTIONING ITEMS

[illegible]

Activity 2

Select instructional materials from your own occupational specialty, and use those materials as a basis in developing four comprehension exercises.

First, select four paragraphs, one illustrating each of the following organizational patterns: time sequence, simple listing, cause and effect, and comparison/contrast. Then copy each paragraph and devise an exercise appropriate for its pattern.

The exercises should stress students' ability (1) to determine which organizational pattern is used and (2) to identify main ideas and details. If possible, have students develop a chart, diagram, or other visual representation as part of at least one of your exercises.

Feedback 3

After you have completed your four comprehension exercises, arrange to have your resource person review and evaluate your exercises. Give him/her the Comprehension Exercises Checklist, p. 51, to use in evaluating your work.

COMPREHENSION EXERCISES CHECKLIST

Directions: Place an X in the NO, PARTIAL, or FULL box to indicate that each of the following performance components was not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, a performance component was not applicable, or impossible to execute, place an X in the N/A box.

Name

Date

Resource Person

LEVEL OF PERFORMANCE

	N/A	No	Partial	Full
Each of the comprehension exercises:				
1. was appropriate to the selected occupational reading materials on which it was based	☐	☐	☐	
2. was appropriate to the maturity level and reading abilities of the students for which it was intended	☐	☐	☐	
3. accurately dealt with the organizational pattern on which it was focused	☐	☐	☐	
4. required students to comprehend the material in order to complete the exercise correctly	☐	☐	☐	
5. included clear and easy-to-follow directions for the students	☐	☐	☐	
6. was clear regarding the type of response desired	☐	☐	☐	
7. was free of errors and attractively presented	☐	☐	☐	
The four comprehension exercises:				
8. included at least one appropriate chart, diagram, etc., for students to complete	☐	☐	☐	
9. involved responses at various levels of comprehension	☐	☐	☐	
10. were varied in regard to content and approach	☐	☐	☐	

Level of Performance: All items must receive FULL or N/A responses. If any item receives a NO or PARTIAL response, review the material in the information sheet, Developing Comprehension Skills, pp. 40–49, revise your exercises accordingly, or check with your resource person if necessary.

NOTES

Learning Experience IV

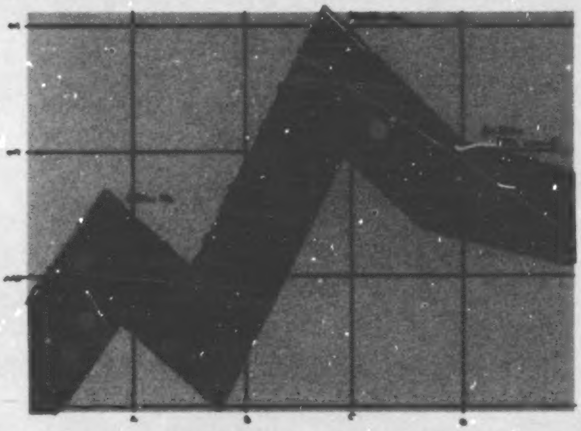
OVERVIEW

Enabling Objective

Activity 1

The average person often needs to use information that is presented graphically. Nowhere are graphics more important than in vocational-technical education. For information concerning the skills involved in reading graphics, as well as practical procedures to be followed in developing graphics reading exercises, read the following information sheet.

DEVELOPING GRAPHICS EXERCISES



Modern textbooks and instructional materials in all vocational-technical programs use a far greater variety and quantity of graphic material than were used even a generation ago. Photographs, drawings, paintings, cartoons, graphs, charts, diagrams, tables, and maps all appear frequently in today's materials.

The purposes served by graphics of all kinds are (1) to reinforce and clarify concepts contained within the printed text and (2) to make the text's appearance more interesting and attractive. Although most visual presentations have features in common, each kind has its own special way of conveying information. This is true even within a particular class of graphic material.

By their nature, some graphics may be more suited than others to the presentation of a particular piece of information. For example, which would be of more help in showing how an electrical circuit works? A schematic diagram? Or a gorgeous photograph of an electrical device that took first place in the science fair? The schematic diagram would, of course, be more helpful.

Teachers are sometimes not aware of how useful a good visual aid can be. An entire lesson or learning guide may be built around one graph, chart, diagram, or photograph. Using graphics and careful questioning techniques, you can help students discover concepts that might be too difficult or abstract for them in verbal form.

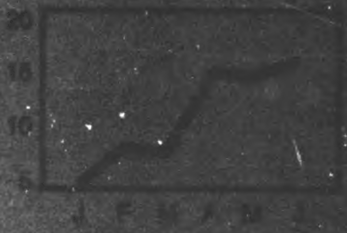
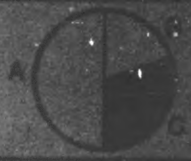
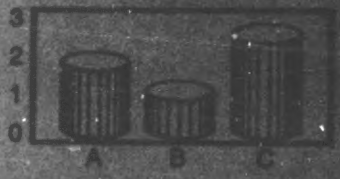
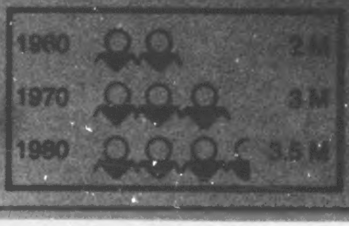
However, in order to lead students through an interpretation of graphic materials with ease and confidence, you must be aware of the kinds of graphic materials, how each kind can be used, and the reading skills required for each kind. This information is presented in chart form in samples 16, 17, and 18.

In addition to using graphics as instructional devices within a lesson, you should ensure that students are capable of understanding the graphics they will encounter in their texts and on the job. If graphics are to be as effective a tool as they can be, you must teach students to read them critically—to analyze and interpret them and to make inferences and draw conclusions based on the information provided.

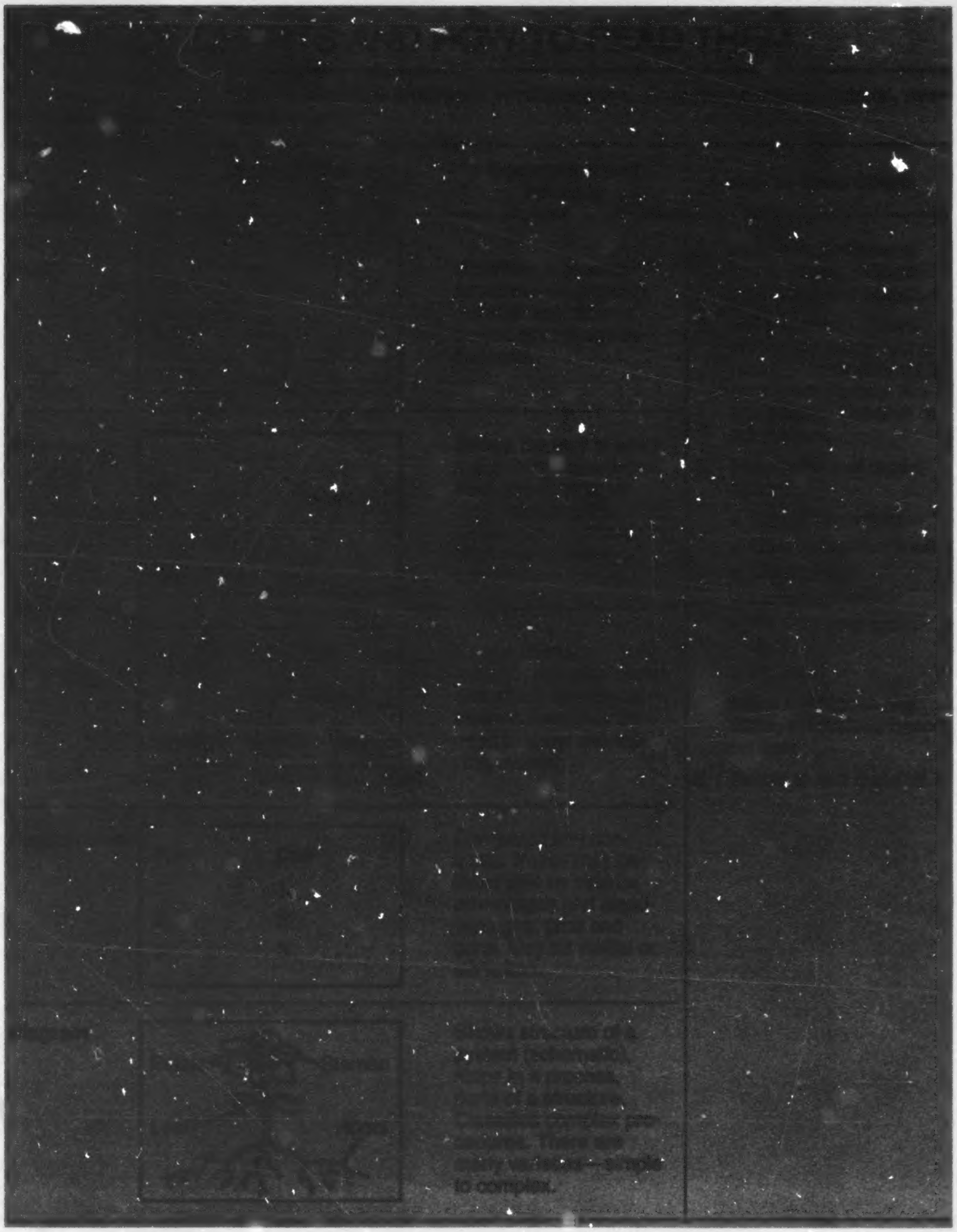
SAMPLE 16

TYPES OF GRAPHS AND HOW TO READ THEM

Graphs are visual rep [illegible]

Types of Graphs		[illegible]	
Line		[illegible]	
Bar		[illegible]	
Circle or Pie		Shows how various parts equal a whole. Illustrates percentages.	[illegible]
Solid Figure		[illegible] spheres, cylinders, etc.	[illegible]
Picture or Pictograph (Pictogram)		[illegible] such as people, boxes, cows, or other items being compared.	[illegible]

SAMPLE 17



There are many variations—simple to complex.

SAMPLE 18

TYPES OF ILLUSTRATIONS AND HOW TO READ THEM

Types	Description	Purpose	How to Read Illustrations
Photograph	Most realistic two-dimensional illustration. May be abstract, however. May be distorted due to selection, point of view, and/or editing.	Generates interest. Motivates. Clarifies text by providing a sense of reality. Effectively shows step-by-step procedures; comparisons; states of things, processes, scenes, events, people.	1. Read title or caption. This may be misleading. If so, is there a reason? 2. Survey illustration; get gestalt impression. 3. Look for details—objects, colors, symbols, people, relationships. 4. Make inferences, draw conclusions, seek applications. 5. Refer to text in order to determine how to read illustration. Sense of author's purpose for using it. 6. Repeat step 4.
Painting, Drawing	Wide variety in type and style. Most realistic portrayal of prephotography eras. Often found in history, literature, and psychology texts. May provide interpretation of a scene, event, person. May represent abstract ideas, feelings, emotions.	Effectively demonstrates values, styles, and concerns of an era, group of persons, or individuals. Compares and contrasts values, styles, and concerns of eras, groups of persons, individuals. Visual poetry.	
Cartoon	Compact pictorial representation of ideas, employing caricature, symbolism, exaggeration, humor, satire. Variety of artistic techniques. Frequently biased, distorted views. May employ symbols, which can become outdated because they usually are related to events, styles, thoughts of the era in which they appear. Relies on stereotypes. Purpose must be perceived in order to read the meaning.	Gains attention. Illustrates ideas, opinions. Criticizes, satirizes, prophesies. Introduces humor. Induces self-examination, self-criticism.	

Class Discussions Based on Graphics

A great deal of literal information can often be collected from a single graph, chart, or illustration. It would be unfortunate, however, if you allowed your students to confine their "reading" of graphics to this most basic level of comprehension. You should also teach students to read graphics at higher levels of comprehension, such as interpretation and application.

Review the graph in sample 19. The following discussion illustrates how oral questioning based on a graph may move through all levels of thinking and comprehension, from low to high.

First, focus on the title of the graph. It is always important to call attention to the title of a graphic, because it establishes the main idea and indicates purpose. This is a point to be kept in mind when producing your own visuals: always give them titles. Although the content and meaning of a graph or chart may be perfectly obvious to its creator, it may remain a mystery to another person unless a hint (such as a title) is given.

Second, teach necessary vocabulary. One way to do this is to ask students questions that lead them to discover the meaning of key terms. In discussing sample 19, for instance, you could ask the class if anyone knows what *per capita* means. If no one responded, you could then ask the following series of questions:

- Do you know any other words that contain the root word *cap*? [capital, cap, decapitate]
- What is a capital? [seat of the head of government; first letter at the head of every sentence]
- What is a cap? [type of headwear]
- What does a guillotine do when it decapitates you? [cuts off your head]

From this it can be established that *cap* refers to the head. Therefore, *per capita* means per head, or per person.

Third, point out the various parts of the graph and identify the details that support the main idea. Then, you can ask questions about the details. For example, questions such as the following could be asked about sample 19:

- What do the solid black bars represent?
- What do the solid white bars stand for?
- What kind of information is given across the bottom of the graph? What are the intervals, or increments?
- Is there a break in the sequence? How do you know?
- What kind of data are being presented on the vertical scale? What are the intervals, or increments?

Although this series of questions may seem easy to you, students may need to identify the separate elements before they are ready to "read" the data—the next step in the teaching sequence. Remember, in leading your students through this kind of process, your purpose is not just to teach content. You are also trying to teach a skill—one that can transfer to reading any graphics, whether they occur in your program, in other subject areas, on the job, or in personal reading.

Fourth, begin asking questions about the factual content of the graph. In discussing the factual content of sample 19, for example, the following questions might be asked:

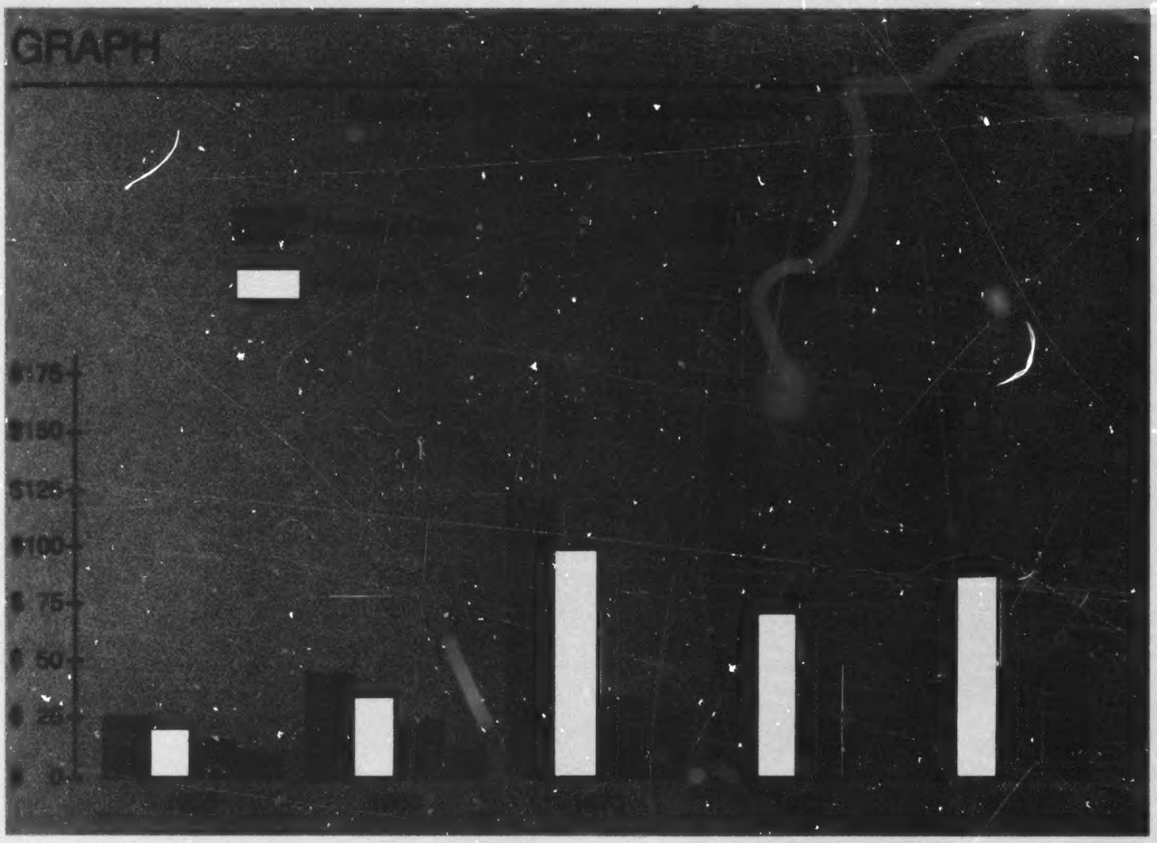
- Approximately how much money was spent per person for hospital care in 1950? in 1960?
- How much was the increase in terms of dollars during those ten years?
- What was the percentage of increase?

Too often, discussion of a graph begins with this last question. However, many students (new to graph reading) must mentally go through an entire sequence of questions, such as those listed, in order to collect enough data to answer this question. And, they must do so quickly because the teacher may allow only a few seconds of thinking time before expecting an answer.

Fifth, after getting factual information from the graph, begin asking higher-order questions to help students interpret and analyze the graph. The following higher-order questions could be asked concerning sample 19:

- How much money was spent on hospital care in 1970?
- What is the percentage of increase over the amount spent in 1960?
- Why do you think it increased so much?
- Let's use our local hospital as an example. Do you know whether any kind of development or expansion was done during the late '60s? [Many hospitals did expand during that time.]
- Why? [Several answers may be given. Usually someone will say that more people wanted hospital care.]
- Why was there greater demand for hospital care? [Many reasons may be suggested. Medicare may be mentioned. A major reason for hospital expansion in the 1960s was the fact that many people who previously could not afford hospital care began to seek medical attention.]
- Can you think of other reasons for the increased costs? [Building materials and labor costs were rising, which in turn increased the cost of building rooms, staffing them, and occupying them. This could lead into a discussion

SAMPLE 19



SOURCE: *Journal of Medical Education.* 49 (January 1974): 9.

of inflation. It might also be mentioned that many hospitals added intensive care and cardiac units at that time, which also increased costs because of advancing technology and specialized staffing.

Note that most of this part of the discussion is generated by inferences made from the scant data presented on the graph. It could lead into hypothesizing future costs based on trends established in the past.]

- Looking at the first two years of the 1970s, what do you predict hospital costs will be in the 1990s if these trends continue?

Finally, pursue a similar analysis of other parts of the graph. For sample 19, an analysis of physicians' services could be pursued. The topic of national health insurance could easily arise. Several questions could be generated about this topic, as follows:

- What countries do you know of that have national health insurance programs?
- What are the good (bad) features of such programs?
- What have been the responses to such programs in these countries.
- Who pays for these programs?

Most students won't have specific answers to these questions. However, if they are interested, such questions could lead them to do some research in the resource center or local library.

It is difficult to portray an enthusiastic class discussion in print. However, from the previous example, it can be seen that an entire lesson could be devoted to the reading, interpretation, and discussion of a rather simple graph. This particular graph could be used in a nursing class or in other allied health programs. It could be used as a lead-in to a particular topic, to a chapter in a text, or to extended library research.

A graphic may be used in any class and for any purpose. Regardless of the specifics, in order to help students develop skill in reading graphics—while also learning about the required subject matter—a line of questioning must be used that requires the use of reasoning skills to seek information beyond the literal level.

Written Exercises Based on Graphics

You can develop exercises based on important graphics found within your program materials. Samples 20 and 21 illustrate types of written exercises you could develop to help students acquire various skills in reading graphics.

If a graphic appears in your exercise (and it probably will), it is especially important that the graphic be accurately drawn and labeled. Students can't be expected to derive correct information from a messy drawing.

If you are unable to produce good graphics yourself, you may be able to get assistance from the graphics or media staff in your school or college. A teacher in the technical drawing program may be able to help. Obviously, if your program deals with the production of graphics (e.g., engineering drawing or construction design), your own graphics must be beyond reproach.

As in all materials you produce for class use, graphics reading exercises must be clearly written. Directions to the student must be simple and concise. Statements should be free of grammatical or typographical errors. And each exercise should be cleanly and attractively reproduced.

Student-Made Graphics

Once students have practiced reading and interpreting various kinds of graphics, you should give them the opportunity to produce their own. Many students like to do this because it poses a real challenge and adds variety to classroom activities. In order to devise a graphic, the student will have had to (1) read the relevant portion of the text, (2) select the main idea and supporting details, and (3) understand the relationship.

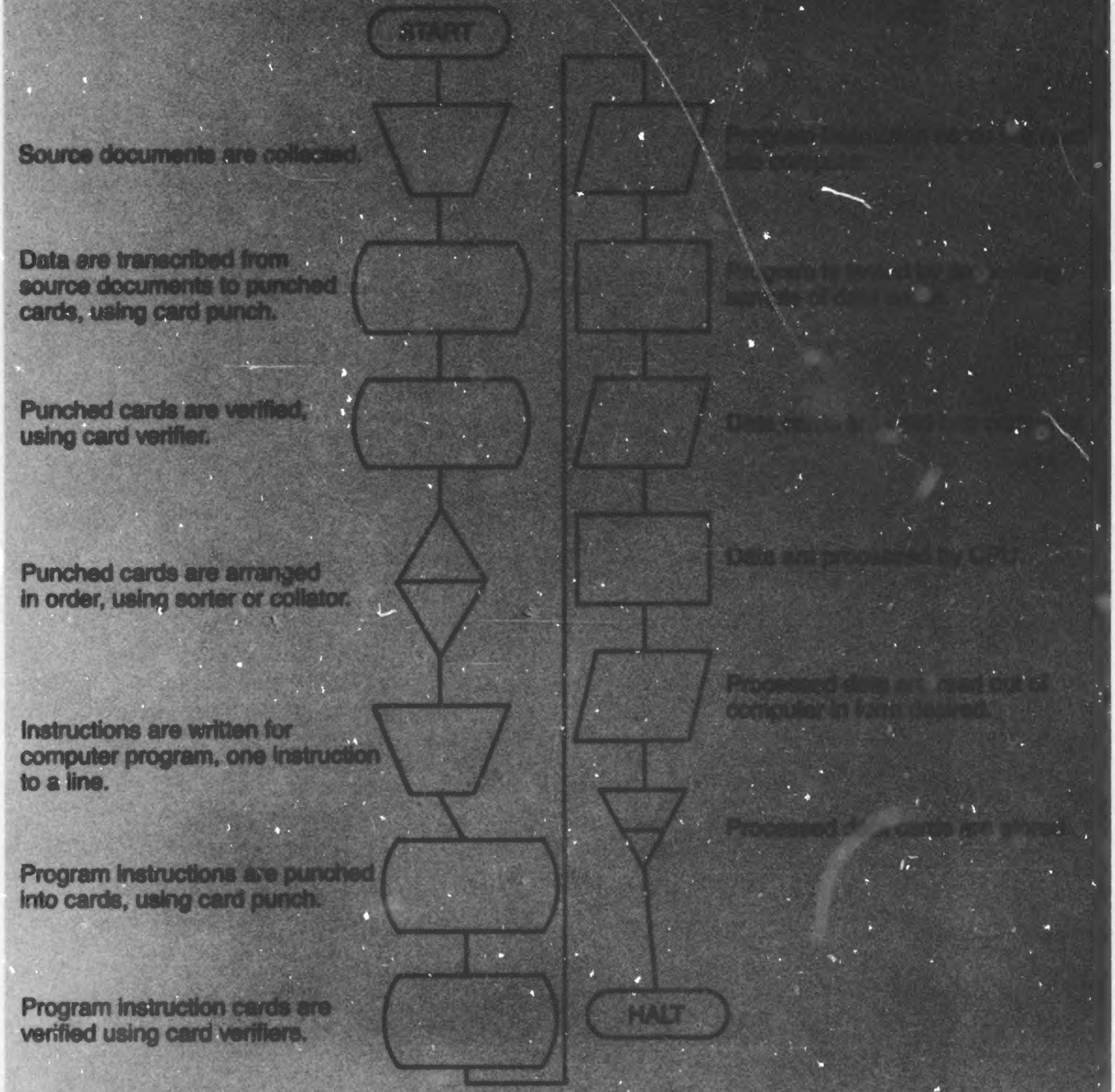
Students' ability to select an appropriate visual form into which to translate this relationship demonstrates their understanding of both the purposes that graphics serve and the uses to which the information presented can be put. The graphic form forces students to think clearly and to express their thoughts briefly. Students who succeed at this task have read critically, thought critically, and organized their thinking well.

SAMPLE 20

GRAPHICS EXERCISE: FLOW CHART

Vocational Program: Data Processing

Directions: Review the flow chart for processing data. Then respond to [illegible]


START
Source documents are collected.
Data are transcribed from source documents to punched cards, using card punch.
Punched cards are verified, using card verifier.
Punched cards are arranged in order, using sorter or collator.
Instructions are written for computer program, one instruction to a line.
Program instructions are punched into cards, using card punch.
Program instruction cards are verified using card verifiers.
Program [illegible] computer.
Program is [illegible]
Data [illegible]
Data are processed by CPU.
Processed data are read out of computer in form desired.
Processed [illegible] cards are [illegible]
HALT

1. This flow chart follows the standard format for all data processing flow charts. When reading the flow chart, which of the following procedures is the correct method to use? (Check one.)
   - ____ a. Read from top to bottom, right to left.
   - ____ b. Read from bottom to top, right to left.
   - ____ c. Read from bottom to top, left to right.
   - ____ d. Read from top to bottom, left to right.

2. Since a standard format is followed for reading flow charts, is it necessary to label the START and HALT functions as was done on this flow chart? ____________________

3. A procedure is a step-by-step set of instructions for performing an operation. Would it be correct to say that this flow chart is a pictorial/symbolic representation of a procedure? ____________________

4. Each step or sequence in a flow chart identifies a particular process that takes place during that step. What process takes place just before the CPU begins processing data? ____________________

5. Are data cards normally read into the computer before or after instruction cards? ____________________

6. The operation printed beside each symbol is a clue to the meaning of the symbol. Does a parallelogram mean more than one thing? ____________________

7. Name at least four basic machines or devices mentioned in this flow chart that are used to process data. ____________________

8. Excluding the START and HALT functions, there are 13 sequential steps in this flow chart. How many different symbols are used to represent these steps? ____________________

9. Look at the long line that extends from the step in which "program instruction cards are verified, using card verifier," to the next step. Does this long line indicate there is a delay of some sort between these steps? ____________________

10. If a single step were to be removed from this flow chart, would it make much difference? Why? ____________________

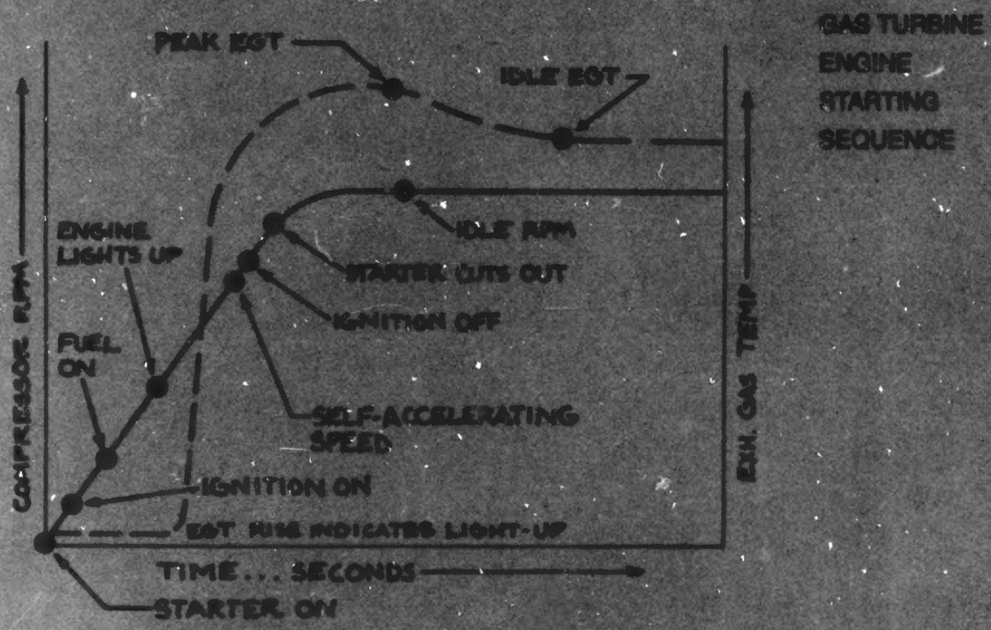
Answer Key: (1) d; (2) Yes; (3) Yes; (4) Data cards are read into computer; (5) After; (6) Yes, it means reading in (inputting) or reading out (outputting); (7) Card punch, card verifier, sorter or collator, computer; (8) Six; (9) No; (10) Yes, the steps are shown as a sequence, each step necessary to the procedure; none are shown as optional.

SAMPLE 21

GRAPHICS EXERCISE: LINE GRAPH

Vocational Program: Aircraft Engines

Directions: The graph shown below is identical to the one found on page 107 in your assigned reading. Information relating to it can be found on pages 105 and 106. Study the graph, and then answer the questions that follow.



1. What is the title of the graph? ______________________________

____

2. Identify the following from the graph:

   a. What variable is being dealt with on the left-hand vertical scale on the graph? ____________

   b. What variable is being dealt with on the bottom horizontal scale on the graph? ____________

   c. What variable is being dealt with on the right-hand vertical scale on the graph? ____________

3. Moving from left to right on the graph, what is happening to time?

   _____ It is increasing. _____ It is decreasing.

4. Moving from bottom to top on the graph, what is happening to the following:

   a. Compressor RPM?

   _____ It is increasing. _____ It is decreasing.

b. Exhaust gas temperature?

____ It is increasing.   ____ It is decreasing.

5. Which two variables are being compared by the dotted line on the graph?

____ Exhaust gas temperature and time

____ Compressor RPM and time

6. Which two variables are being compared by the solid line on the graph?

____ Exhaust gas temperature and time

____ Compressor RPM and time

7. Relating to the "compressor RPM versus time" plot line, identify the first five things that occur in the starting sequence.

1. ____________________   4. ____________________

2. ____________________   5. ____________________

3. ____________________

8. Dealing with the "temperature versus time" plot line, identify which of the five items in #7 occur prior to an EGT rise indicating light up. ____________________

9. In the starting sequence for a gas turbine engine, which happens first?

____ The ignition is turned off.

____ The starter cuts out.

10. Between which two events in the starting sequence is the engine's peak starting EGT reached?

Between ____________ and ____________

11. How does the EGT at idle compare to the "peak starting EGT"?

____ It is higher.   ____ It is lower.

12. How can the difference in the idle and starting EGTs be explained? ____________________

13. When, in relation to the engine attaining self-accelerating speed, does the starter cut out?

____ Before   ____ Right at   ____ After

What need might the engine have that would require the starter to cut out at this time? ____________________

Answer Key: (1) Gas Turbine Engine Starting Sequence; (2a) Compressor RPM; (2b) Time in seconds; (2c) Exhaust gas temperature; (3) Increasing; (4a) Increasing; (4b) Increasing; (5) Exhaust gas temperature and time; (6) Compressor RPM and time; (7) Starter on, ignition on, fuel on, engine lights up, self-accelerating speed reached; (8) The first four; (9) Ignition off; (10) Starter cuts out; idle EGT; (11) Lower; (12) Higher temperature reached because of ignition; (13) After; needs to begin cooling; temperature is peaking.

Activity 2

Select two representative graphics from instructional materials used in your own occupational specialty. If possible, use two that are of quite different types.

For each graphic, develop a student exercise on reading graphics, including at least ten sample questions. Include questions in each exercise that require students to extract information, make inferences, analyze, and draw conclusions. Attach a copy of the graphic to your questions and cite the source.

Feedback 3

After you have completed your graphics reading exercises, arrange to have your resource person review and evaluate your exercises. Give him/her the Graphics Reading Checklist, p. 67, to use in evaluating your work.

NOTES

GRAPHICS READING CHECKLIST

Directions: Place an X in the NO, PARTIAL, or FULL box to indicate that each of the following performance components was not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, a performance component was not applicable, or impossible to execute, place an X in the N/A box.

Name ____________________

Date ____________________

Resource Person ____________________

LEVEL OF PERFORMANCE

	N/A	No	Partial	Full
The graphics reading exercises developed by the teacher:				
1. were appropriate to the subject matter and student level	☐	☐	☐	
2. required students to:				
a. extract literal information from the graphic	☐	☐	☐	
b. analyze the information presented	☐	☐	☐	
c. make inferences	☐	☐	☐	
d. draw conclusions	☐	☐	☐	
3. followed the proper procedures for "reading" the particular type of graphic selected	☐	☐	☐	
In each completed reading exercise:				
4. the questions/items were clearly and simply written	☐	☐	☐	
5. the sequence of questions/items followed a logical order	☐	☐	☐	
6. all key questions/items were included	☐	☐	☐	
7. the graphic was accurately and clearly produced	☐	☐	☐	
8. clear directions were provided	☐	☐	☐	
9. reproduction was neat and legible	☐	☐	☐	

Level of Performance: All items must receive FULL or N/A responses. If any item receives a NO or PARTIAL response, review the material in the information sheet, Developing Graphics Exercises, pp. 54–64, revise your exercises accordingly, or check with your resource person if necessary.

NOTES

Learning Experience V

OVERVIEW

Enabling Objective

After completing the required reading, [illegible]

Activity 1

You will be reading the information sheet, [illegible] ing Skills, pp. [illegible]

Optional Activity 2

You may wish to [illegible]

Activity 3

You will be completing a text analysis of a sample of instructional material selected from your own occupational specialty.

Feedback 4

Your competency in analyzing instructional materials will be assessed by your resource person, using the Materials Analysis Checklist, p. [illegible]

Activity 1

In planning to teach technical reading skills, you need to consider the reading requirements of specific instructional materials and your students' skills in relation to those requirements. How well prepared are your students to handle the vocabulary, comprehension, and graphic skills that the materials demand? For information concerning how to analyze instructional materials and how to plan to teach reading in your vocational-technical program, read the following information sheet.

PLANNING TO TEACH TECHNICAL READING SKILLS

As you begin planning for teaching technical reading skills in your program, you have three related responsibilities. First, you must **know your students.** You must know students' general abilities and interests, their overall reading level as a group, their individual reading levels, and any special reading problems they may have.

Second, you must choose and use written instructional materials that are **appropriate** for your occupational area and for your students' needs and abilities.

Third, you must **analyze** the instructional materials to determine what skills your students need in order to read those materials efficiently, effectively, and with greater ease and comprehension.

Your task is specific. You want to help students cope with their learning assignments and with the written materials of their occupations. Thus, before you begin planning to teach reading, you must have certain knowledge and skills in three important areas of reading: vocabulary, comprehension, and graphics.

You must have **knowledge** of the technical vocabulary in your specialty area, the process of reading comprehension, and the use of graphics. Furthermore, you must have **skill** in developing activities and exercises to teach your students technical vocabulary, to aid them in comprehension, and to help them understand and use graphics.

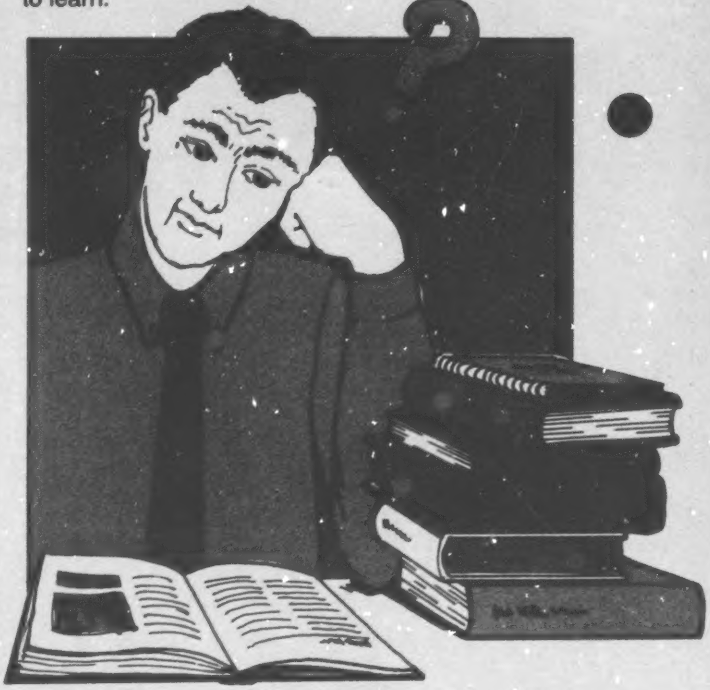
As you develop your plans to teach reading, you must consider all the reading skills that your students will need to use. Although these skills can be considered separately, they should not be taught separately. In planning, you can use your own knowledge and skills in the three areas to help students develop and apply their own skills as they read.

The steps involved in planning to teach reading may seem familiar. The procedure is similar to that of developing daily lesson plans. The difference lies in shifting the focus from teaching **content** to teaching **how to read and understand** the content.

Reading the Materials

The first step—that of carefully reading the material to be assigned—seems obvious. However, instructors who have been using the same materials for several years sometimes fail to reread them each time they use them. They may forget what information is actually there.

But reading the material is not enough. It is **how** you read the materials that is perhaps the most important aspect in the teaching of reading, because it is through careful analysis that you will determine what is to be taught and what skills students need to learn.



Analyzing the Materials

In analyzing instructional materials you are, essentially, asking a series of questions about the materials:

Concepts

- What are the important concepts?
- If the concept is a process, is there a chart or diagram that presents the process visually? If so, should the focus of the initial discussion be on the chart or diagram?
- What topics are covered? (List them as you read. Often headings and subheadings are provided.)

Vocabulary

- What technical terms are used to describe the concepts and processes?
- What are the relationships between and among these words? That is, do the meanings of some words have to be known first because they become essential components in the definitions of other terms?
- How are the words presented in the materials?
- What would be the best way to teach these words?

Organization

- How is the information presented? That is, how does the author organize the material? Is he/she primarily comparing or contrasting? Is he/she providing instruction in how to do something using a step-by-step procedure?
- How much and what kind of background do the students need to have in order to understand the information?
- Does the author provide clear signal words as clues to organizational patterns?
- Are there key paragraphs that could be used as the basis for comprehension exercises?

Reading Skills Needed

- At what readability level are the materials written?
- Are the students asked to draw conclusions? Will they have to demonstrate their knowledge by applying the information (or procedures) in another situation?
- If a number of steps or ingredients are involved, must the students remember them in a particular order?
- What visual aids are presented in the materials? Which ones seem to be the most helpful in clarifying the concepts or procedures explained in the materials? How do the graphics convey information?

The answers to these and other questions will determine the objectives to be set for a reading assignment. They will also help you determine what activities and materials should be developed in order to aid the students in meeting those objectives.

Using a Text Analysis Chart

You might find it helpful to use a simple chart as an aid in analyzing instructional materials. As you prepare to teach the reading assignment, a text analysis chart forces you to organize your thinking by providing space for recording the various elements of the reading. There should be space in the chart for noting the following:

- **Major concepts or ideas**—Make note of the really important ideas in the reading that you want to be sure your students do not miss—for example, an abstract principle (e.g., supply and demand), a formula, a law of physics, or an essential operating procedure.
- **Topics covered in the reading**—Describe the way in which the subject matter is organized, divided, and sequenced.
- **Essential vocabulary**—Record the new words you want every student to know at the end of the lesson or the unit.
- **Organizational pattern**—Note how the author goes about providing the information (e.g., comparison, cause and effect, or time sequence).
- **Reading/study skills needed**—List any particular skills students must have in order to gain from the reading assignment. The skills may include such things as reading graphics, using a book index, or analyzing words.
- **Important visual aids**—This entry may include the visuals in the materials themselves, visuals in other books or learning guides, or other visual aids you supply to students to help them understand the reading.

Samples 22 and 23 are examples of completed text analysis charts. You can easily draw up and duplicate a similar chart form for your own use.

SAMPLE 22

TEXT ANALYSIS CHART

Vocational Program: Aircraft Engines

Chapter two: Turbine Engine Components

Major Concepts I. Turbine engine construction and design II. Turbine engine systems	**Content Topics** **(as listed in text)** I. Core engine components II. Accessories III. Starters IV. Fuel systems V. Lubrication systems VI. Ignition systems VII. Protection against icing
Essential Vocabulary Aerodynamic Afterburner Axial compressor Burner can Buzz Centrifugal compressor Clamshell reverser Compressor stall (surge) Diffuser Drag Exhaust nozzle Impulse/reaction turbine Screech Trim	**Organizational Pattern** Comparison/contrast Listing Cause and effect
Reading/Study Skills Needed Using charts and tables Reading graphs Analyzing schematics Note taking Word analysis (context clues, structural analysis) Using book parts	**Important Visual Aids** Pictures of inlet ducts, p. 63 Picture of centrifugal compressor, p. 71 Picture of axial compressor, p. 72 Picture of diffuser, p. 79 Picture of burner cans, p. 83 Picture of turbine assembly, p. 87 Picture of exhaust nozzle, p. 92 Picture of clamshell reverser, p. 95 Picture of afterburner, p. 102 Starting sequence graph, p. 107 Fuel control schematic, p. 115 Oil system schematic, p. 126

	Resources for [illegible]		
People	Places	[illegible]	[illegible]
Technical representative from General Electric	Turbine engine overhaul [illegible] facility, Jacksonville [illegible]	[illegible]	[illegible]
Field representative, Eastern Airlines	Kennedy Space Center, [illegible] Merritt Island, F[illegible]	[illegible]	[illegible]
Mechanic for NASCAR's turboprop aircraft			

SAMPLE 23

TEXT ANALYSIS CHART

Vocational Program: Health Occupations

Chapter: The Circulatory System

Major Concepts

Circulation of blood

Content Topics
(as listed in text)

I. Blood
  A. Components
  B. Grouping
  C. Rh factor
  D. Clotting
II. Heart
III. Blood vessels
IV. Lymphatic system
V. Related skills
  A. Blood pressure
  B. Taking pulse

Essential Vocabulary

Anemia
Antibodies
Antigens
Diastolic pressure
Embolism
Fibrinogen
Leukemia
Leukocytosis
Leukopenia
Myocarditis
Pericarditis
Plasma
Prothrombin
Serum
Systolic pressure
Thrombosis
Thrombus

Organizational Pattern

Listing
Cause and effect
Compare/contrast
Categories
Step-by-step

Reading/Study Skills Needed

Note taking
Using drawings, diagrams, and charts

Important Visual Aids

Drawings on pages 124, 131, 132
Diagrams on pages 127, 128, 130, 133, 134, 136, 137, 138, 139
Diagrams on overhead projector
Anatomical chart
Human anatomy specimens

Resources for Background and Motivation

People	Places	Media	Other
Laboratory technologist Pathologist Cardiologist Nurse Patient with heart prosthesis EKG technician	Hospital Cardiac screening unit Bloodmobile Blood bank	Filmstrip: "Circulation" Filmstrip: "Blood Pressure" Film: "Heritage of Operating Room D," Arco Films, 26 min.	Blood typing kit Rh typing kit Pacemaker Sphygmomanometer Stethoscope

Planning the Instruction

After you have analyzed your instructional materials, the next step is to write student performance objectives for the lesson. The objectives should reflect reading skill development, as well as content development. The following are examples of such objectives:

- Pronounce and define the fifteen new vocabulary words related to service contracts.
- Given the manufacturer's written installation instructions, assemble and install a waste disposal unit in a standard sink without assistance or supervision.
- Locate and read the appropriate tables for cutting speeds/lathe RPM in *Machinery's Handbook*.

Introducing the Reading

After analyzing your instructional materials and developing objectives, you should consider some ways to introduce the reading assignment to your students. You may need to build the additional background that they will need in order to succeed. And you will want to create interest and provide motivation. There are many ways to do this.

For example, you could present a film that deals with the topic in an up-to-the-minute, stimulating way. You could organize a field trip that would generate questions, the answers to which can be found in the reading assignment. A subject matter expert invited to your class could serve much the same purpose.

Or, you might prepare an illustrated talk designed to provide an overview of the topic. Detailed information could be deliberately omitted from the talk—information that students can only secure by completing one or more reading assignments.

In this planning stage, you should list as many of these options as you can. When you get ready to actually teach the lesson, you can then select the ones you think would be the most effective and beneficial.

Developing a Study Guide

Once this phase of the planning is complete, you can then prepare various exercises that will extend and develop the reading skills required. Some vocational-technical teachers have found it helpful to put exercises together in a "study guide" for a unit of study.

Study guides may vary in length, emphasis, and format, depending on the type of reading assignment or the type of skills required in order to complete the assignment. The study guide is an especially useful tool if you have students with varying abilities. Each part of the guide can be designed to emphasize a distinct skill or to be appropriate for a certain level of comprehension. Individual student assignments may then be made for various parts of the guide as needed.

It is not always necessary for everyone to do all the activities included in the study guide. You can assign students at various levels to complete different sections of the guide. For each student, there is a level at which he or she is **able** to respond successfully.

The best study guides frequently include a number of elements:

- Vocabulary exercises
- Comprehension exercises based on both graphic and verbal materials
- Exercises that stress patterns of organization or the use of various study skills
- Enrichment activities

These exercises and activities are presented in a variety of formats: diagrams, charts, outlines to be completed, essay and short-answer (true-false, multiple-choice, matching, completion) items, acrostics and other puzzles, and so forth.

Enrichment Activities

Study guides may also include activities that involve students in projects, library research, or other investigations within or outside the class or the school. By making these activities a part of the study guide, you can directly tie reading to application.

Sample 24 is an example of enrichment activities designed for both individual and group work. If you review the text analysis chart that was presented in sample 22, you can see how these activities are direct outgrowths of the reading. Notice how diverse such activities can be and how they tie the reading to practical application. Through such enrichment activities, students can directly relate what they have read to the world of work.

SAMPLE 24

ENRICHMENT ACTIVITIES

Directions: The following activities will require searching for information that may or may not be contained in the textbook. You are to select and complete, by the end of the unit, one of the individual project [illegible] and one of the group project activities.

The group projects [illegible] a group of from three to five individuals. You may form the group yourself or the instructor will assign you to a group of students interested in the same project. Items 1–6 require a written report. Items 7–8 are to be done in the laboratory.

1. **Individual Project**

   Spend a day at the airport terminal (your local airport or nearby one) and make a note of every type of turbine-powered aircraft that [illegible] of the four types of [illegible] engines [illegible] and describe the design of the inlet, compressor, combustor, turbine, nozzle and exhaust.

2. **Individual Project**

   View the [illegible] supplied by General Electric [illegible] of the engines you have examined in the laboratory.

3. **Individual Project**

   Go to a turbine engine repair station and interview the maintenance technicians. Find out what their educational backgrounds are, what types of work they do, what they would recommend to a technician in training, and various other career-related items. Present your findings to the class in written and oral form, highlighting what the turbine engine technician does in the field.

4. **Individual Project**

   Go to the library and review issues of the magazine *Aviation Week and Space Technology* that span the last ten years. Select a few issues that have articles on new turbine engine technology. Prepare a report on the technological changes that have occurred in the last ten years, as reported in the magazine. This report should only highlight those changes. It should not be an in-depth engineering report.

5. **Individual Project**

   Write to at least five oil companies and obtain available technical information on the turbine engine oils they supply. Compare and contrast chemical and operational characteristics of the five oils. This comparison should include viscosity, pour point, flash point, type identification, and temperature operating range. Prepare your comparison and contrast analysis in the form of a chart.

6. **Individual Project**

   Write to one of the manufacturers of turbine engines. Request information on the engines they produce that would fit into one of the four engine categories: turbojet, turbofan, turboprop, and turboshaft. Equipped with this information, prepare a graph or chart comparing the engines' similarities and differences in performance.

7. **Group Project for Three**

   From the instructor, obtain the pressurizing and dump valve for the Pratt and Whitney JT-3 engine, the project book, and the maintenance manual for that engine. Following the instructions in the project book, disassemble the component, complete the schematic that is supplied, trace the flow through the component, do operational testing, and finally, assemble the component. Prepare written answers to the questions in the back of the project book.

8. **Group Project for Three**

   From your instructor, obtain the Lycoming T-53 fuel control, the project book, and the T-53 fuel control overhaul manual. Following the procedures outlined in the project book, disassemble and inspect the fuel control. Complete the flow chart supplied with the project book. Using the overhaul manual, identify all the major components of the fuel control. Following the instructions in the project book, assemble the fuel control. Prepare written answers to the questions in the back of the project book.

9. **Group Project for Four**

From your instructor, obtain the Lycoming T-53 power turbine assembly and the project book for the overhaul of the T-53 power turbine. Following the procedures outlined in the project book, disassemble and inspect the power turbine. Complete the limits table supplied in the project book by using measuring instruments, such as micrometers, depth gauges, and T gauges. Determine the airworthiness of the component. Following the instructions in the project book, assemble the power turbine assembly. Prepare written answers to the questions in the back of the project book.

10. **Group Project for Five**

From your instructor, obtain the Airesearch GTP-30 auxiliary power unit, the project book, and the operational instructions manual for the same unit. Following the procedures outlined in the project book, complete the familiarization for the power unit. Still following the procedures, disassemble the hot section and inspect it. While the unit is disassembled, answer the questions in the back of the project book.

After answering the questions in the project book, follow the procedures to assemble the power unit. In preparation for running the unit on the test cell, prepare a test run sheet as outlined in the project book. Take the unit to the test cell and operate it as outlined in the project book. Record all the power unit's parameters on the test run sheet you prepared.

Optional Activity 2

For further information about teaching reading in vocational-technical programs and for samples of reading exercises, you may wish to read the following supplementary reference: Shepherd, *Comprehensive High School Reading Methods*, pp. 321–331. Another source of ideas for teaching reading is Thomas and Robinson, *Improving Reading in Every Class*, pp. 449–470.

Activity 3

On the following pages are (1) a text analysis chart and (2) a simple study guide form. Using instructional materials from your occupational specialty and the form on pp. 79–80, prepare a text analysis of an appropriate section of material.

Based on your completed text analysis chart, use the form on pp. 81–82 to develop a study guide for teaching the reading assignment.

Feedback 4

After you have completed the text analysis chart and the study guide, arrange to have your resource person review and evaluate your work. Give him/her the Materials Analysis Checklist, p. 83, to use in evaluating your work.

Text Analysis Chart

Vocational program: ______________________________

Chapter or section of material: ______________________________

Major Concepts	**Content Topics**
Essential Vocabulary	**Organizational Pattern**

81

Reading/Study Skills Needed	Important Visual Aids

Resources for Background and Motivation

People	Places	Media	Other

Study Guide

Objectives:

Teaching Methods:

83

Learning Activities:

Feedback:

MATERIALS ANALYSIS CHECKLIST

Directions: Place an X in the NO, PARTIAL, or FULL box to indicate that each of the following performance components was not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, a performance component was not applicable, or impossible to execute, place an X in the N/A box.

Name ____________________

Date ____________________

Resource Person ____________________

	LEVEL OF PERFORMANCE			
	N/A	No	Partial	Full
In preparing an analysis of selected instructional materials, the teacher:				
1. accurately identified each of the following:				
a. all important concepts	☐	☐	☐	[redacted]
b. key topics covered	☐	☐	☐	[redacted]
c. new vocabulary words used	☐	☐	☐	[redacted]
d. basic organizational pattern used	☐	☐	☐	[redacted]
e. all visual devices used	☐	☐	☐	[redacted]
f. key reading skills needed	☐	☐	☐	[redacted]
2. identified a variety of potential resources to be used	☐	☐	☐	[redacted]
The teacher's study guide for reading instruction:				
3. included appropriate performance objectives for the lesson	☐	☐	☐	[redacted]
4. included objectives for both reading skills and content	☐	☐	☐	[redacted]
5. identified appropriate teaching methods to be used	☐	☐	☐	[redacted]
6. identified appropriate student learning activities for the lesson	☐	☐	☐	[redacted]
7. included activities at a variety of reading levels	☐	☐	☐	[redacted]

Level of Performance: All items must receive FULL or N/A responses. If any item receives a NO or PARTIAL response, review the material in the information sheet, Planning to Teach Technical Reading Skills, pp. 70–77, revise your work accordingly, or check with your resource person if necessary.

NOTES

Learning Experience VI

FINAL EXPERIENCE

Terminal Objective

[illegible]

Activity

1

[illegible]

Feedback

2

[illegible]

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*For a definition of "actual teaching situation," see the inside back cover.

NOTES

TEACHER PERFORMANCE ASSESSMENT FORM

Assist Students in Developing Technical Reading Skills (M-2)

Name ____________________

Date ____________________

Resource Person ____________________

Directions: Indicate the level of the teacher's accomplishment by placing an X in the appropriate box under the LEVEL OF PERFORMANCE heading. If, because of special circumstances, a performance component was not applicable, or impossible to execute, place an X in the N/A box.

	LEVEL OF PERFORMANCE					
	N/A	None	Poor	Fair	Good	Excellent
In preparing to teach technical reading skills, the teacher:						
1. analyzed program instructional materials to determine specific reading skills needed	☐	☐	☐	☐		
2. planned specific activities to integrate the teaching of reading with occupational skills training	☐	☐	☐	☐		
3. prepared vocabulary exercises and activities that:						
a. were appropriate for the material to be covered	☐	☐	☐	☐		
b. included a reasonable amount of new specialized and technical terms	☐	☐	☐	☐		
c. were pitched at the right level for the intended audience	☐	☐	☐	☐		
d. included all information students needed in order to learn the terms	☐	☐	☐	☐		
4. prepared comprehension exercises and activities that:						
a. were appropriate to the selected occupational reading materials on which they were based	☐	☐	☐	☐		
b. were appropriate to the maturity level and reading abilities of the students for which they were intended	☐	☐	☐	☐		
c. accurately dealt with the organizational pattern on which each was focused	☐	☐	☐	☐		
d. required students to comprehend the material in order to complete each exercise correctly	☐	☐	☐	☐		
e. required students to identify significant elements in each selected reading	☐	☐	☐	☐		
f. involved responses at various levels of comprehension	☐	☐	☐	☐		
g. were varied in regard to context and approach	☐	☐	☐	☐		

	N/A	None	Poor	Fair	Good	Excellent
5. prepared graphics reading exercises and activities that:						
a. were appropriate to the occupational subject matter and student level	☐	☐	☐	☐		
b. followed the proper procedures for "reading" the particular type of graphic selected	☐	☐	☐	☐		
c. included all key questions, presented in a logical order	☐	☐	☐	☐		
d. required students to extract significant information, analyze the information presented, make inferences, and/or draw conclusions	☐	☐	☐	☐		
e. included accurate and clearly drawn graphics	☐	☐	☐	☐		
6. produced exercises for student use that:						
a. included clear directions	☐	☐	☐	☐		
b. were legible and visually attractive	☐	☐	☐	☐		
c. were free of grammatical and typographical errors	☐	☐	☐	☐		
7. prepared enrichment activities designed to extend student interest and reading skills	☐	☐	☐	☐		
In conducting instructional activities related to reading skills, the teacher:						
8. introduced each reading assignment to build background and motivate students	☐	☐	☐	☐		
9. used a variety of instructional techniques to strengthen students' reading skills	☐	☐	☐	☐		
10. integrated the teaching of reading throughout the occupational training program	☐	☐	☐	☐		
11. incorporated specially devised learning activities and enrichment activities designed to improve students' skills in:						
a. vocabulary	☐	☐	☐	☐		
b. comprehension	☐	☐	☐	☐		
c. graphics	☐	☐	☐	☐		
12. used various activities to provide application opportunities	☐	☐	☐	☐		

Level of Performance: All items must receive N/A, GOOD, or EXCELLENT responses. If any item receives a NONE, POOR, or FAIR response, the teacher and resource person should meet to determine what additional activities the teacher needs to complete in order to reach competency in the weak area(s).

ABOUT USING THE NATIONAL CENTER'S PBTE MODULES

Organization

Each module is designed to help you gain competency in a particular skill area considered important to teaching success. A module is made up of a series of learning experiences, some providing background information, some providing practice experiences, and others combining these two functions. Completing these experiences should **enable** you to achieve the **terminal** objective in the final learning experience. The final experience in each module always requires you to demonstrate the skill in an actual teaching situation when you are an intern, a student teacher, an inservice teacher, or occupational trainer.

Procedures

Modules are designed to allow you to individualize your teacher education program. You need to take only those modules covering skills that you do not already possess. Similarly, you need not complete any learning experience within a module if you already have the skill needed to complete it. Therefore, before taking any module, you should carefully review (1) the introduction, (2) the objectives listed on p. 4, (3) the overviews preceding each learning experience, and (4) the final experience. After comparing your present needs and competencies with the information you have read in these sections, you should be ready to make one of the following decisions:

- That you do not have the competencies indicated and should complete the entire module
- That you are competent in one or more of the enabling objectives leading to the final learning experience and, thus, can omit those learning experiences
- That you are already competent in this area and are ready to complete the final learning experience in order to "test out"
- That the module is inappropriate to your needs at this time

When you are ready to complete the final learning experience **and** have access to an actual teaching situation, make the necessary arrangements with your resource person. If you do not complete the final experience successfully, meet with your resource person and arrange to (1) repeat the experience or (2) complete (or review) previous sections of the module or other related activities suggested by your resource person before attempting to repeat the final experience.

Options for recycling are also available in each of the learning experiences preceding the final experience. Any time you do not meet the minimum level of performance required to meet an objective, you and your resource person may meet to select activities to help you reach competency. This could involve (1) completing parts of the module previously skipped, (2) repeating activities, (3) reading supplementary resources or completing additional activities suggested by the resource person, (4) designing your own learning experience, or (5) completing some other activity suggested by you or your resource person.

Terminology

Actual Teaching Situation: A situation in which you are actually working with and responsible for teaching secondary or postsecondary vocational students or other occupational trainees. An intern, a student teacher, an inservice teacher, or other occupational trainer would be functioning in an actual teaching situation. If you do **not** have access to an actual teaching situation when you are taking the module, you can complete the module **up to** the final learning experience. You would then complete the final learning experience later (i.e., when you have access to an actual teaching situation).

Alternate Activity or Feedback: An item that may **substitute** for required items that, due to special circumstances, you are unable to complete.

Occupational Specialty: A specific area of preparation within a vocational service area (e.g., the service area Trade and Industrial Education includes occupational specialties such as automobile mechanics, welding, and electricity).

Optional Activity or Feedback: An item that is not required but is designed to **supplement** and enrich the required items in a learning experience.

Resource Person: The person in charge of your educational program (e.g., the professor, instructor, administrator, instructional supervisor, cooperating/supervising/classroom teacher, or training supervisor who is guiding you in completing this module.

Student: The person who is receiving occupational instruction in a secondary, postsecondary, or other training program.

Vocational Service Area: A major vocational field: agricultural education, business and office education, marketing and distributive education, health occupations education, home economics education, industrial arts education, technical education, or trade and industrial education.

You or the Teacher/Instructor: The person who is completing the module.

Levels of Performance for Final Assessment

N/A: The criterion was not met because it was **not applicable** to the situation.

None: **No attempt** was made to meet the criterion, although it was relevant.

Poor: The teacher is unable to perform this skill or has only **very limited ability** to perform it.

Fair: The teacher is unable to perform this skill in an acceptable manner but has **some ability** to perform it.

Good: The teacher is able to perform this skill in an **effective** manner.

Excellent: The teacher is able to perform this skill in a **very effective** manner.

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Titles of the National Center's Performance-Based Teacher Education Modules

Category A: Program Planning, Development, and Evaluation

A-1 Prepare for a Community Survey
A-2 Conduct a Community Survey
A-3 Report the Findings of a Community Survey
A-4 Organize an Occupational Advisory Committee
A-5 Maintain an Occupational Advisory Committee
A-6 Develop Program Goals and Objectives
A-7 Conduct an Occupational Analysis
A-8 Develop a Course of Study
A-9 Develop Long-Range Program Plans
A-10 Conduct a Student Follow-Up Study
A-11 Evaluate Your Vocational Program

Category B: Instructional Planning

B-1 Determine Needs and Interests of Students
B-2 Develop Student Performance Objectives
B-3 Develop a Unit of Instruction
B-4 Develop a Lesson Plan
B-5 Select Student Instructional Materials
B-6 Prepare Teacher-Made Instructional Materials

Category C: Instructional Execution

C-1 Direct Field Trips
C-2 Conduct Group Discussions, Panel Discussions, and Symposiums
C-3 Employ Brainstorming, Buzz Group, and Question Box Techniques
C-4 Direct Students in Instructing Other Students
C-5 Employ Simulation Techniques
C-6 Guide Student Study
C-7 Direct Student Laboratory Experience
C-8 Direct Students in Applying Problem-Solving Techniques
C-9 Employ the Project Method
C-10 Introduce a Lesson
C-11 Summarize a Lesson
C-12 Employ Oral Questioning Techniques
C-13 Employ Reinforcement Techniques
C-14 Provide Instruction for Slower and More Capable Learners
C-15 Present an Illustrated Talk
C-16 Demonstrate a Manipulative Skill
C-17 Demonstrate a Concept or Principle
C-18 Individualize Instruction
C-19 Employ the Team Teaching Approach
C-20 Use Subject Matter Experts to Present Information
C-21 Prepare Bulletin Boards and Exhibits
C-22 Present Information with Models, Real Objects, and Flannel Boards
C-23 Present Information with Overhead and Opaque Materials
C-24 Present Information with Filmstrips and Slides
C-25 Present Information with Films
C-26 Present Information with Audio Recordings
C-27 Present Information with Televised and Videotaped Materials
C-28 Employ Programmed Instruction
C-29 Present Information with the Chalkboard and Flip Chart
C-30 Provide for Students' Learning Styles

Category D: Instructional Evaluation

D-1 Establish Student Performance Criteria
D-2 Assess Student Performance: Knowledge
D-3 Assess Student Performance: Attitudes
D-4 Assess Student Performance: Skills
D-5 Determine Student Grades
D-6 Evaluate Your Instructional Effectiveness

Category E: Instructional Management

E-1 Project Instructional Resource Needs
E-2 Manage Your Budgeting and Reporting Responsibilities
E-3 Arrange for Improvement of Your Vocational Facilities
E-4 Maintain a Filing System
E-5 Provide for Student Safety
E-6 Provide for the First Aid Needs of Students
E-7 Assist Students in Developing Self-Discipline
E-8 Organize the Vocational Laboratory
E-9 Manage the Vocational Laboratory
E-10 Combat Problems of Student Chemical Use

Category F. Guidance

F-1 Gather Student Data Using Formal Data-Collection Techniques
F-2 Gather Student Data Through Personal Contacts
F-3 Use Conferences to Help Meet Student Needs
F-4 Provide Information on Educational and Career Opportunities
F-5 Assist Students in Applying for Employment or Further Education

Category G: School–Community Relations

G-1 Develop a School–Community Relations Plan for Your Vocational Program
G-2 Give Presentations to Promote Your Vocational Program
G-3 Develop Brochures to Promote Your Vocational Program
G-4 Prepare Displays to Promote Your Vocational Program
G-5 Prepare News Releases and Articles Concerning Your Vocational Program
G-6 Arrange for Television and Radio Presentations Concerning Your Vocational Program
G-7 Conduct an Open House
G-8 Work with Members of the Community
G-9 Work with State and Local Educators
G-10 Obtain Feedback about Your Vocational Program

Category H: Vocational Student Organization

H-1 Develop a Personal Philosophy Concerning Vocational Student Organizations
H-2 Establish a Vocational Student Organization
H-3 Prepare Vocational Student Organization Members for Leadership Roles
H-4 Assist Vocational Student Organization Members in Developing and Financing a Yearly Program of Activities
H-5 Supervise Activities of the Vocational Student Organization
H-6 Guide Participation in Vocational Student Organization Contests

Category I: Professional Role and Development

I-1 Keep Up to Date Professionally
I-2 Serve Your Teaching Profession
I-3 Develop an Active Personal Philosophy of Education
I-4 Serve the School and Community
I-5 Obtain a Suitable Teaching Position
I-6 Provide Laboratory Experiences for Prospective Teachers
I-7 Plan the Student Teaching Experience
I-8 Supervise Student Teachers

Category J: Coordination of Cooperative Education

J-1 Establish Guidelines for Your Cooperative Vocational Program
J-2 Manage the Attendance, Transfers, and Terminations of Co-Op Students
J-3 Enroll Students in Your Co-Op Program
J-4 Secure Training Stations for Your Co-Op Program
J-5 Place Co-Op Students on the Job
J-6 Develop the Training Ability of On-the-Job Instructors
J-7 Coordinate On-the-Job Instruction
J-8 Evaluate Co-Op Students' On-the-Job Performance
J-9 Prepare for Students' Related Instruction
J-10 Supervise an Employer–Employee Appreciation Event

Category K: Implementing Competency-Based Education (CBE)

K-1 Prepare Yourself for CBE
K-2 Organize the Content for a CBE Program
K-3 Organize Your Class and Lab to Install CBE
K-4 Provide Instructional Materials for CBE
K-5 Manage the Daily Routines of Your CBE Program
K-6 Guide Your Students Through the CBE Program

Category L: Serving Students with Special/Exceptional Needs

L-1 Prepare Yourself to Serve Exceptional Students
L-2 Identify and Diagnose Exceptional Students
L-3 Plan Instruction for Exceptional Students
L-4 Provide Appropriate Instructional Materials for Exceptional Students
L-5 Modify the Learning Environment for Exceptional Students
L-6 Promote Peer Acceptance of Exceptional Students
L-7 Use Instructional Techniques to Meet the Needs of Exceptional Students
L-8 Improve Your Communication Skills
L-9 Assess the Progress of Exceptional Students
L-10 Counsel Exceptional Students with Personal–Social Problems
L-11 Assist Exceptional Students in Developing Career Planning Skills
L-12 Prepare Exceptional Students for Employability
L-13 Promote Your Vocational Program with Exceptional Students

Category M: Assisting Students in Improving Their Basic Skills

M-1 Assist Students in Achieving Basic Reading Skills
M-2 Assist Students in Developing Technical Reading Skills
M-3 Assist Students in Improving Their Writing Skills
M-4 Assist Students in Improving Their Oral Communication Skills
M-5 Assist Students in Improving Their Math Skills
M-6 Assist Students in Improving Their Survival Skills

RELATED PUBLICATIONS

Student Guide to Using Performance-Based Teacher Education Materials
Resource Person Guide to Using Performance-Based Teacher Education Materials
Guide to the Implementation of Performance-Based Teacher Education
Performance-Based Teacher Education: The State of the Art, General Education and Vocational Education

For information regarding availability and prices of these materials contact—AAVIM, American Association for Vocational Instructional Materials, 120 Driftmier Engineering Center, University of Georgia, Athens, Georgia 30602, (404) 542-2586

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